Contents

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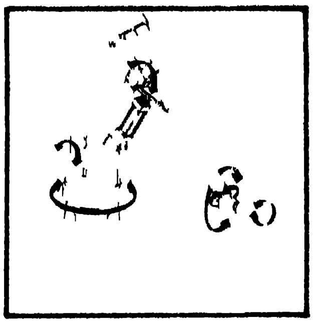
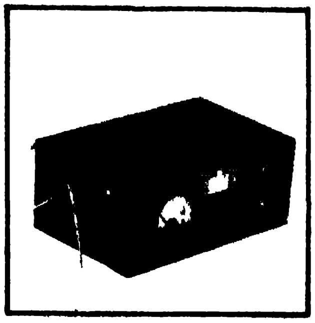
Are Robots Coming



33 With the accent on precision and speed, automation in industry has become imminent and with it the use of robots Applications, installation, current international robotics trends and safety measures required while working with these 'man machines are discussed in this article

—Dr N Vanvari

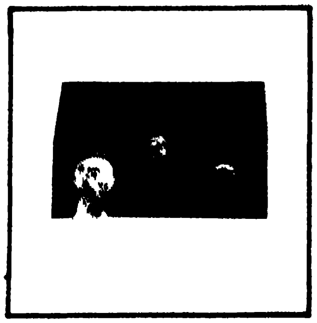


Automatic AC Voltage Regulator

70 A number of solidstate automatic voltage regulators are available in the market But in most of them the controlling elements are usually relays or motor-driven variacs and cannot truly be termed as solidstate Here is a 'true' solidstate voltage regulator without a single moving element in the circuitry

—Balakrishna P

STD/Local Bar



76 Over-charging of telephone bills is not an uncommon occurence in India One prime reason for this is the use of the STD facility in proxy This simple STD/Local bar instrument enables the subscriber to switch the STD facility on or off as and when required

—P Jayavardhana Krishnan

21 CMOS Technology Catching Up *—Y K Shah*
27 Microprocessor Control of Diesel Generator *—C S Prasanna Kumar*
33 Are Robots Coming? *—Dr N Vanvari*
39 Czechoslovakia The Electronics Boom *—Antonin Filip*
47 Principle of Moving Head Disc *—S Batra*
55 Digital Resistance, Capacitance and Frequency Measurements Using Sinclair Spectrum Micro *—Ajay Chikersal*
62 Comparative Study of Computer Languages *—R. Ramaswamy*
70 Solidstate Automatic AC Voltage Regulator *—Balakrishna P*
76 STD/Local Bar to Prevent Over-charging *—P. Jayavardhana Krishnan*

FEATURES

14 Letters
17 What's New
43 Computer Corner
48 Electroons
70, 76 Construction
83 Circuit Ideas
91 Product Profiles
102 Book Reviews
103 Company Profiles
106 Facts & Figures
111 Electronics Mart

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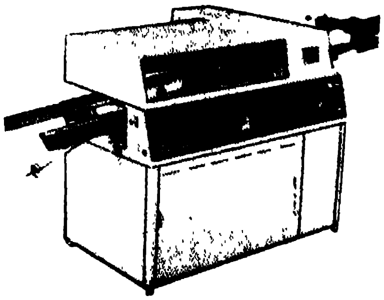

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KAVERI

Programmable Volume Control

This refers my 'Programmable Volume Control' circuit idea in EFY's November issue Two mistakes have crept up in the article First, the last line of the text is wrongly printed as "R11 is about 47 kilohms for the zener diode used" It should be read as 'R11 is about 47 ohms for the zener diode used' Second, the pull-down resistors connected to the BCD thumbwheel switch are marked R11, R12, R13 and R14 They should have been marked as R12, R13 R14 and R15 respectively

BIDYUT CHAKRABORTY
Distt Nadia, W B

Inexpensive Multitester

Kindly refer our circuit idea captioned 'Inexpensive Multitester' published in December issue of EFY

In the circuit diagram, the switch numbers have been wrongly printed. S2 shall come in place of S1 and vice-versa

We would like to take this oppurtunity to add that if anyone faces a difficulty with the use of transistor 2N481 for T3, as specified in the diagram, he may use BC158B in place of 2N481, with identical terminal connections Only alteration required in the other part of the circuit is the use of 22kilohm resistor for R5 in place of 1k specified in the diagram This modification shall be useful when someone finds a slight glow in the indicator LED with the test prods unshorted while the unit is powered on and switch S2 is kept at 'test' position

ARUP KUMAR ROY
AND BHABENDRA NATH PAL
Calcutta

Hourly Chime for Digital Clock

Mr A Kadarkarai s article in May 1985 issue was interesting but I noticed a few discrepancies

C10 is shown connected between IC4's pin 6 and ground in circuit diagram, though it is not shown in the components layout for PCB! Similarly C5, included in parts list, is missing from the circuit diagram

G SAHA
Gauhati

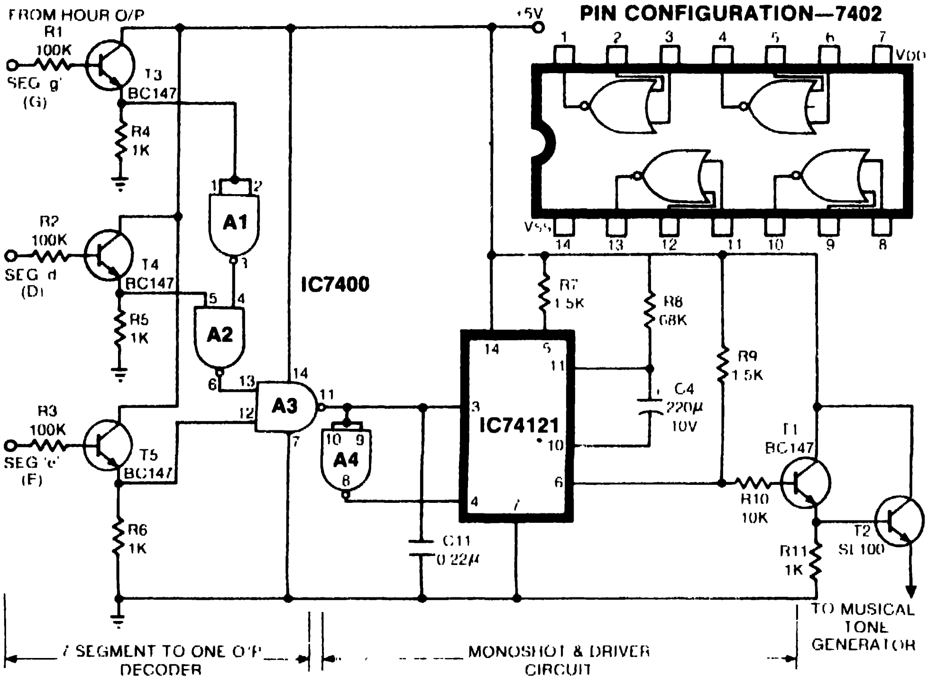
The author uses two ICs to get 'high to low or low to high transition alternately, by taking a f and 'e outputs of hour output of the clock chip The same decoding of 7-segment output can be done using just one IC as given here Instead of 'a, f and 'e take 'e, 'd' and g outputs The IC7400's NAND gates A1 to A3 do the decoding and output a transition every hour as required by the monoshot circuit

The IC7400 NAND gates are used only for low true output clock chips For decoding 'high true' output devices use IC7402 and replace each NAND gate with a NOR gate with the same interconnecting wiring IC7402 s pin configurations are given here as they differ from IC7400

R. MURALI KRISHNAN
Srivilliputtur (TN)

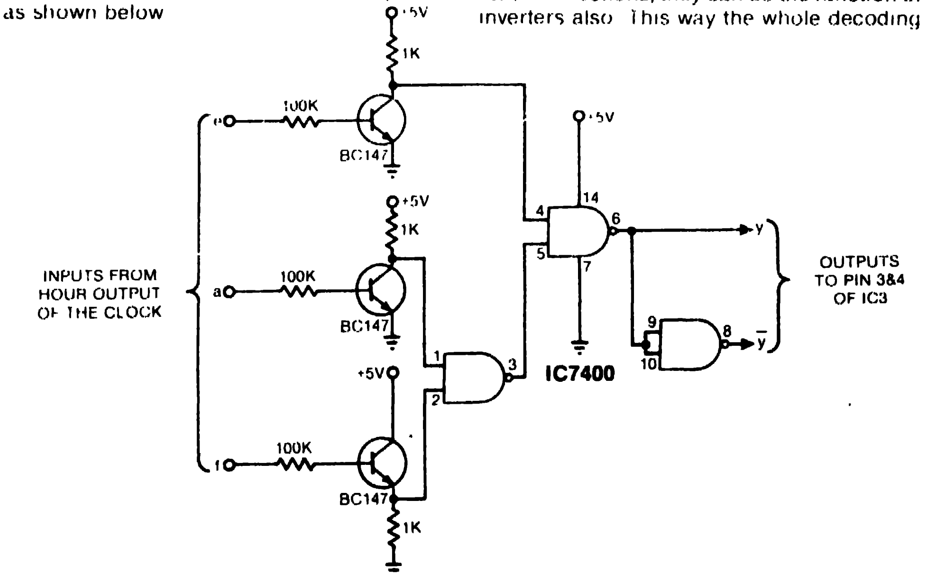
HOURLY CHIME CIRCUIT—(SIMPLIFIED)

BOTTOM VIEW
PIN CONFIGURATION—7402



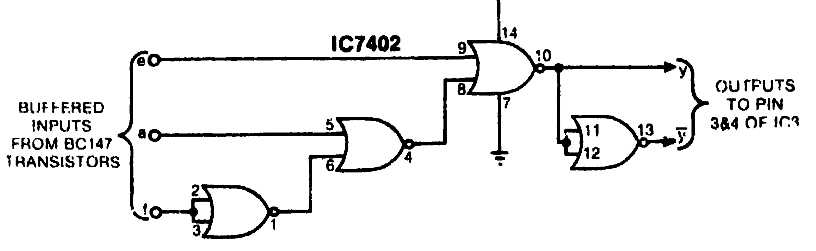
AND gates (A1 and A2) are wrongly shown like NAND gates in the circuit diagram Further, the decoder circuit can be simplified as shown below

This reduces the number of gate ICs to just one With a slight change in the BC147 transistor's connections, they can do the function of inverters also This way the whole decoding



+5V
1K
100K
BC147
INPUTS FROM HOUR OUTPUT OF THE CLOCK
e
a
f
IC7400
OUTPUTS TO PIN 3&4 OF IC3
y
ȳ

$y = \bar{e}\,\bar{a}\,\bar{f} = \overline{e + \bar{a}\,f} = \overline{e + \overline{a + f}}$



+5V
IC7402
BUFFERED INPUTS FROM BC147 TRANSISTORS
e
a
f
OUTPUTS TO PIN 3&4 OF IC3
y
ȳ

circuit reduces to just three NAND gates which can be obtained from a single 7400 IC.

YOGISH KUMAR K.
Puttur D K

The author, Mr . Kadarkaral, replies:
Capacitor C10 mentioned by Mr Saha may be omitted but 5 µF capacitor may be replaced by a 6.4µF. C5 mentioned in the parts list is not required.

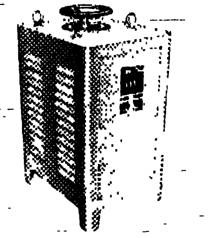
The decoder circuit can be simplified as pointed out by Mr Yogish Kumar But the NOR gate circuit is having some mistake. In the diagram 'a' and 'f' should be interchanged

Mr Murali Krishnan's idea is very correct and interesting. It will work for both 'active high' as well as 'active low' output clock chips

New Policy Measures in Electronics

The above article serialised in October, November and December issues of Electronics For You, was based on various policies and procedures concerning electronics industry announced by the government from time to time These evolved out of a collective work of a number of experts engaged in the field of electronics and collegues working in the Department of Electronics, Electronics Commission (IPAG) and other ministries Therefore I claim no credit for the work except compilation of various facts and figures already available through different documents No personal attribution should be made about statements in the article as they are a reiteration of the already announced policies

Dr S L. SARNOT
Additional Director
Electronics Commission (IPAG)
New Delhi



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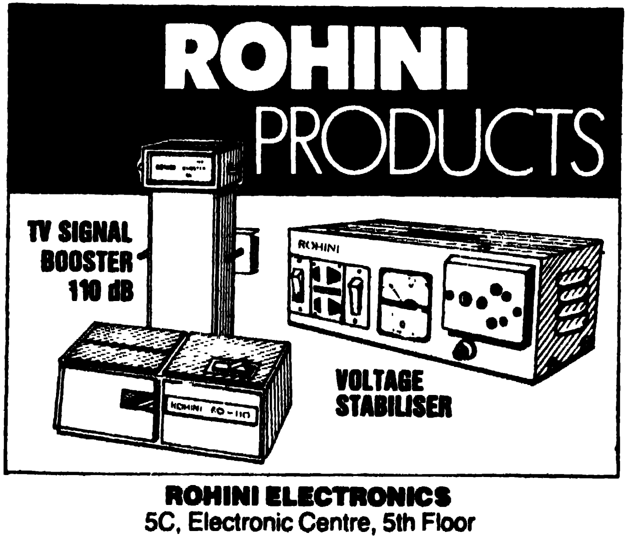

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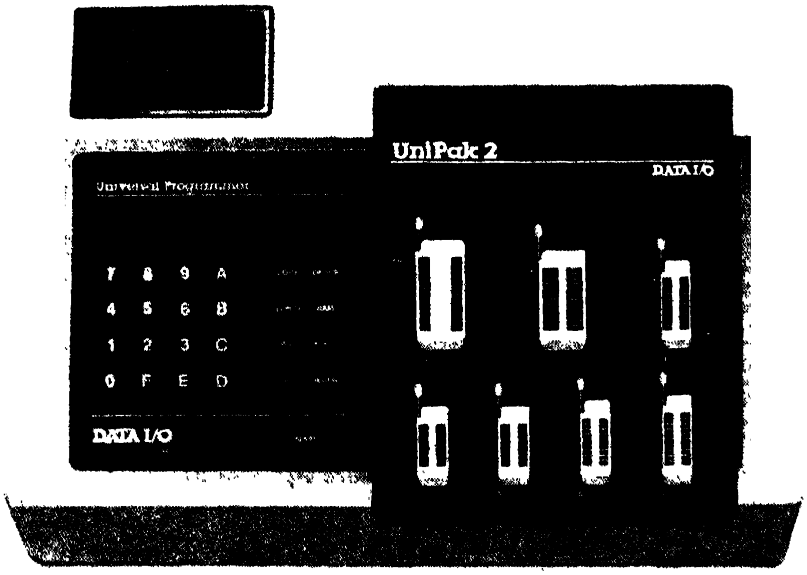

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IN INDIA....

12th AIMTDR Conference

The 12th All India Machine Tool Design and Research conference is scheduled to be held at the Indian Institute of Technology, New Delhi between 10th and 12th December 1986.

The conference serves as a forum for exchange of ideas on topics of current interest pertaining to design, performance, retrofitting and maintenance of machine tools, manufacturing systems, automation, CNC, DNC, CAD, CAM, CIM, FMS, robotics, adaptive control, microprocessor applications, expert systems, metal cutting, metal forming, non-traditional machining processes, metrology, research, development and application in the field of machine tools. It aims at bringing together research workers and practising engineers so that their work could be reported, recent developments discussed, and the latest trends assimilated.

Eminent national and international experts will be invited to participate and deliver keynote addresses on recent advances in vital areas at the conference.

Authors can send original papers in the above fields for presentation at the conference.

IETE's 32nd Annual Function

The Institution of Electronics and Telecommunication Engineers will hold its 32nd annual function from February 15-21, 1986 at Pragati Maidan, New Delhi. Mr P.V. Narasimha Rao, Minister for Human Resources Development will inaugurate the function on 15th February.

Invited and contributed papers will be presented during the technical convention of the function in the following subjects: Communication including acoustics, opto-electronics, signal processing and broadcasting systems, computers and control; office automation; circuits, systems and devices; instrumentation and measurement including industrial electronics electromagnetics including antennae and microwaves.

An exhibition, the IETE Expo '86, will also be held to highlight India's progress in the field of electronics and telecommunication.

The exhibition will relate to current and emerging technologies in telecommunication equipment, instruments, computers, microprocessors, word processors, digital electronics, process control, power electronics, microwave subsystems, components, consumer electronics and defence equipments.

The technical convention will provide a forum to professionals from diverse specialisations to come together for mutual exchange of ideas on current topics of interest in the evergrowing field of electronics and telecommunications

Tamper-proof, computer-readable passports

The government is likely to introduce, in the next few years, computer-readable passports to arrest tampering with them and to expedite immigration and emmigration clearance procedures.

Efforts are being made to acquire optical character reading (OCR) computer which can read and write, and it is expected that by 1990 the format of the passports would be changed suitably to make them computer-readable.

According to Mr Jogesh Tiwari, joint secretary (passports) in the ministry of external affairs, computers installed at the airports would tally signatures or thumb prints in a passport with those in record and thus tighten security.

The first passport in the new format is likely to be issued three years from now and soon after all passports would be changed to the new format.

A feasibility study has already been conducted to computerise passport records in India and Indian mission abroad. He said, in early 1986 passport centres at Delhi, Bombay, Madras and Cochin would be computerised and by 1990, all passport offices linked through the computer.

Electronics units urged to cut costs

Dr M.S Sanjeev Rao, chairman of the Electronics Commission, has warned the electronics industry that it had no option but to improve the quality and cut down the costs of electronics goods in the country.

Inaugurating a workshop on electro-acoustic measurements, Dr Rao referred to the rigid standards demanded by the international markets and said Indian goods left much to be desired in this aspect.

Underlining the importance of electro-acoustics, Dr Rao said that the production of electro-acoustic devices was projected at Rs 2500 million in 1989-90. This amounted to one-tenth of the entire production of consumer electronics estimated at Rs 25,000 million These devices had to be highly reliable for ensuring the quality of various electronic products such as television sets and loudspeakers

Later Mr S R. Vijayakar, secretary, Department of Electronics, said that if Indian electronics industry wanted to make a dent in the international market, it must set its eyes on export of electronics goods This could be possible only if the Indian electronics industry improved the quality and reliability of end-products and geared itself up to face stiff international competition

British aid for CLASS project to continue

Sir Crispin Tickell, permanent secretary of Britain's Overseas Development Administration (ODA), the 'aid' wing of the British Foreign and Commonwealth Office, visited India in December last to discuss various aspects of the British bilateral aid programme to India.

During his stay, Sir Crispin also visited a school which is part of the government's Computer Literacy and Studies in Schools (CLASS) project. Britain has provided £1.3 million in aid to finance this pilot project, launched last year to provide BBC Acorn Model B microcomputers for 250 secondary schools and 50 resources centres throughout India Software and training—both in the UK and in India—have also been provided as part of the package. A proposal for the provision of a further £1.1 million of UK aid for an extension of the pilot project is currently being considered.

The British evaluation report of the CLASS project made the following recommendations: (a) continued British assistance in specific ways—training both in Britain and India, exchange of information and of facilities relating to the present machine as they are developed, and (b) as the training needs become more specialised great care be taken in asessing precise needs and developing specific training courses to achieve them

Peter Scopes, ODA education adviser, has also recommended further ODA assistance for three years.

Hike in TV prices likely

The prices of colour and black-and-white televisions are likely to shoot up by Rs 1000 to Rs 1500 and Rs 500 to Rs 700 respectively in the coming months. This follows the proposed adoption of the new central excise tariff by the centre which proposes to hike excise duty on electronic components from 15 per cent at present to 40 per cent ad valorem, according to Mr Sunder T Vachani, president of Indian Television Manufacturers' Association.

The excise duty component of a colour TV priced Rs 6000 which is presently Rs 900, is expected to shoot up to Rs 2400 This will be exclusive of the sales tax and octroi.

Small-size TV sets, not exceeding 36 cm, which were earlier exempted from excise duty will also be subject to this hiked duty

In the case of a few other electronic components, an excise duty of 20 per cent is proposed to be levied even though these were totally exempted by the union Finance Ministry through a notification on March 17, 1985 These electronic components include resistors, connectors and relays

Foreign tie-ups for picture tube production

Two foreign collaboration proposals were approved by the central government in the area of colour TV picture tubes, one from Punjab Display Devices Ltd—a subsidiary of the Punjab State Industrial Development Corporation (PSIDC), for collaboration with Hitachi Limited, Japan and the other from U.P. Electronics Corporation Ltd, Lucknow for collaboration with Toshiba Corporation and Mitsubishi Corporation Ltd, both from Japan

Giving this information to the Lok Sabha, Mr Shivraj V. Patil, minister of state for Electronics, said in response to a question that foreign collaboration proposal from A.P. Electronics Development Corporation has not yet been received.

In response to another question he said a working group has been set up by the IDBI (Industrial Development Bank of India) in consultation with the Department of Electronics for helping in the speedy processing of loan applications for the electronic components industry.

....AND ABROAD

Semiconductor'86

Two fairs, CEX '86 (International Electronic Components and Equipments trade fair) and Semiconductor'86 (International trade fair for Semiconductor, Manufacturing, Processing, Assembling and Testing) will be held in Korea from 27th to 30th March, 1986.

Semiconductor'86 will hold a major technical conference with a program featuring industry experts in a wide-ranging series of discussions of state-of-the art semiconductor processing, assembly and testing and wafer fabrication and processing.

Indian visitors will get a unique opportunity to establish business contacts with Korea with regard to expanding trade and technical collaborations.

A special group visit is being arranged with the cooperation of leading electricals and electronics associations for the benefit of small and medium scale industrialists, businessmen, technical experts, professionals and executives. The group will visit important commercial centres in Japan, Korea, Taiwan, Hongkong, and Singapore. Visits to leading factories are also being arranged.

Biomedical Engineering Conference

The 8th Annual International Conference of the IEEE Engineering in Medicine and Biology Society will be held at the Worthington Hotel in Fort Worth, Texas from 7th to 10th November, 1986. The conference aims to serve as a focal point for the latest developments involving technology in health care and to bring together the relevant research efforts, the clinical developments and the industrial applications.

This conference is the world's largest meeting in the area of biomedical engineering and computing as reflected by about 500 technical contributions presented in the previous conference in Chicago, by authors from 22 different countries. This year's conference promises to be one of the most exciting technical events covering a wide spectrum of state-of-the-art technologies. Included in the program are also 2-3 sessions on 'health care technology in the third world countries' to be presented by leading experts in the field.

The highlight of the conference will be a special mini-symposium on 'critical and emerging issues in biomedical engineering' aimed to serve as the central nucleus of the technical sessions. The symposium will consist of in-depth coordinated technical tracks with 'diagonal' prognostic tutorials. World leaders will address the tutorial sessions which include advances in rehabilitation engineering, innovations in biomedical engineering, cardiology, communication systems, intelligent devices, artificial organs, biomaterials, etc.

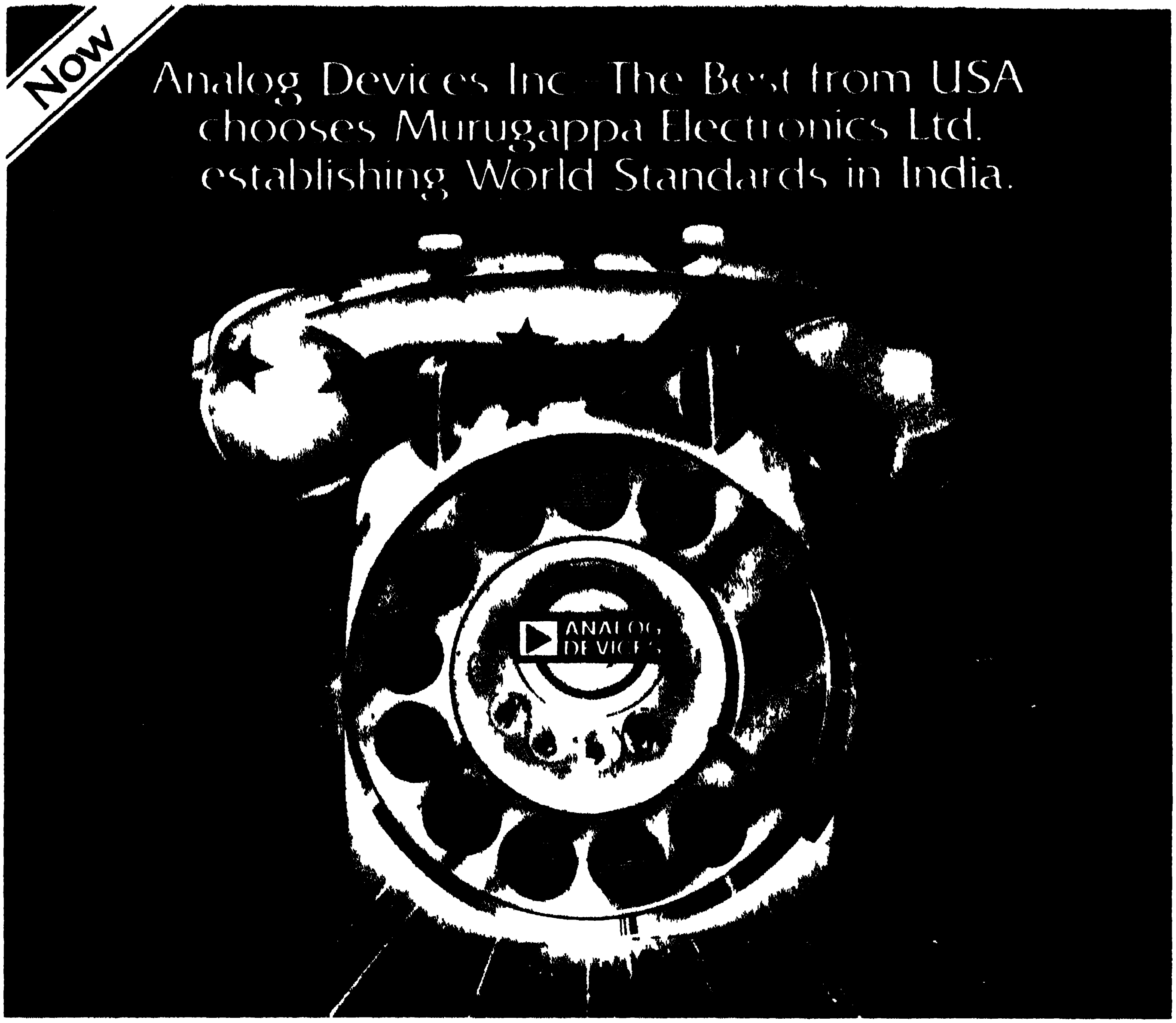
High-Tech Telephones

An unexciting acronym from the field of information technology is the key to a world in which robots on an assembly line will be tuned by engineers in another country, airline tickets will be printed at the user's home and doctors will examine and even treat patients without meeting them.

The term in question is VANS, which stands for value added networks. This rapidly expanding type of service is created by adapting existing communication lines that previously carried only telephone, telex and television.

In the beginning of the 1980s, licensing had been liberalised in Britain to permit a range of VANS, including automatic ticket reservation and issuing, telebanking—using home computer terminal to transfer money from one account to another—and electronic mailboxes which store incoming messages for screen display. In-house information retrieval systems multiplied, eliminating hours of manual searching. For example, extracts from the vast collection of the British Library's—volumes stored on kilometres of shelving—can be flashed on a screen at the touch of a keypad.

Most participants in the world telecommunication industries meet at London agreed there was an exciting future for VANS in a world with 600 million telephones, potentially capable of being linked to on-line information and other interactive services. Many envisaged a world after the turn of the century in which physical operations can be directed through information technology.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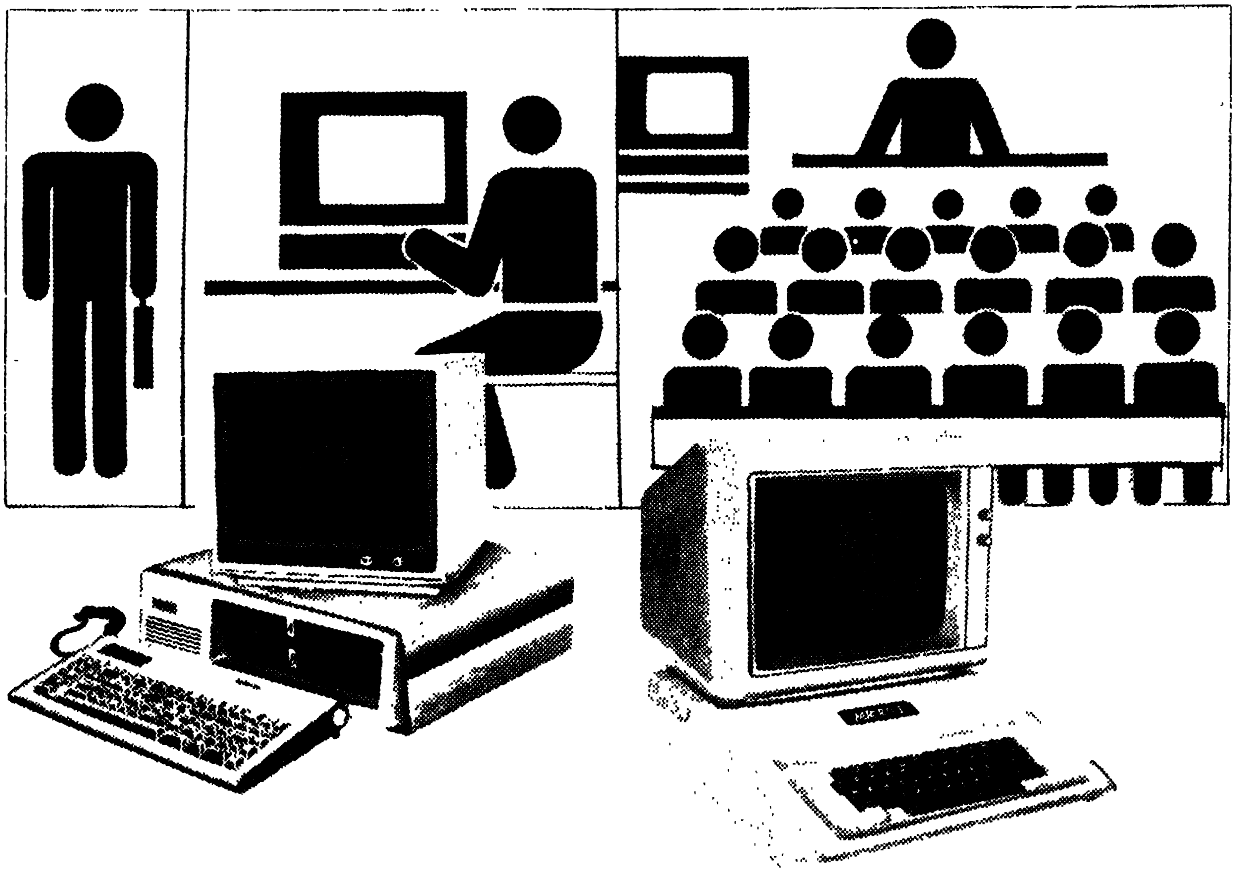

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CMOS Technology: Catching Up

Y.K. Shah

The CMOS (complementary metal oxide semiconductor) technology was always thought of as the ideal technology because of numerous advantages like low power dissipation, high immunity to power-supply noise, symmetric switching characteristics and large supply voltage tolerances.

Despite these obvious advantages, CMOS has rarely been used (till recently) for advanced VLSI microcomputer designs and linear circuits. The reason behind this was the complexity of the CMOS process accounting for a relatively poor price/performance ratio. Owing to this fact, the CMOS found use only in applications that required low power and were neither performance conscious (as in watches and calculators) nor cost conscious (as in military applications).

But now, all of a sudden, all major semiconductor companies have announced advanced CMOS products which could affect the future circuit designs tremendously. A glance at the products announced by Texas, USA will be sufficient to substantiate this.

Texas Instruments has introduced a new series of products known as Lin CMOS which provides the low-power and high-input impedance advantages of CMOS without offset drift and speed problems. Lin CMOS technology is a new processing technology for linear silicon gate CMOS ICs developed exclusively by Texas Instruments. A whole generation of Lin CMOS devices is arriving shortly to provide the power, performance and economy benefits of the new technology to an expanding segment of the linear circuits world such as operation amplifiers, comparators, data acquisition, timers, power supply controllers, line circuits, display drivers, peripheral functions, etc.

And the list may grow indefinitely! It is obvious from the various comparative charts provided by Texas that the above mentioned functions would be smoothly and conveniently performed in a much better manner by Lin-CMOS chips, though at a slightly higher cost at the moment. However, the advantages of the changeover will definitely offset the slight increase in cost.

Before going into an in-depth analysis of these wonderful Lin CMOS devices, let us have a cursory glance at the phenomenon resulting in closer gap between the CMOS technology and MOS technology to be used for VLSI fabrications. As a matter of fact, the dominant VLSI technology (NMOS) is rapidly approaching the process complexity of standard CMOS.

Initially, the LSI circuits were made with p-channel MOS transistors which were relatively slow and difficult to interface to normal integrated circuits (TTL) but made high circuit densities feasible. But soon the NMOS was introduced which provided greater speed (electrons having higher mobility than holes) and TTL compatibility. However, NMOS is more difficult to manufacture than PMOS. Improvement efforts on NMOS brought HMOS by scaling (or shrinking) silicon devices, accomplishing three main advantages, viz, increased speed and density at reduced power.

The improvements in last 10 years in VLSI technology, and the consequent reduction in transistor size at the device level have increased memory density by a factor of 64, speed by a factor of three, and reduced power consumption by a factor of 100. But the scaling cannot continue infinitely because of resolution limitations of the photolithographic equipment used for making the circuits and the breakdown mechanisms within the devices.

In fact, even before these limits are reached, heat dissipation sets in in the NMOS devices. The heat generation increases exponentially with transistors' count. And at densities approaching 150,000 transistors per IC, special cooling measures are required. Evidently, this heat can accelerate failure mechanisms within the silicon, thus reducing the system reliability. To overcome this barrier, low-power devices had to be made and the industry turned to CMOS as a potential alternative.

The CMOS achieves its low-power dissipation through the use of both p-and n-channel transistors (hence the name 'complementary'). In CMOS, there is no dissipation of DC power in either logical state, and AC power occurs only during the relatively short switching period. Since most of the circuitry in the design is active only for 10 to 20 per cent of the time, CMOS achieves a dramatic reduction in power dissipation compared with NMOS which continually dissipates DC power whenever an operating voltage is applied. To understand this difference better, operation of a simple inverter of NMOS and CMOS is considered briefly.

The NMOS inverter uses an n-channel depletion mode transistor as the pull-up device (which drives the output line high) and an n-channel enhancement mode transistor as the pull-down device (which drives the output line low). The pull-up transistor is used as a load; its operation approximates that of a constant current source. The pull-down transistor is used as the switching device. When active, it

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charge the load. MOS loads are primarily capacitive and include the parasitic capacitances of the inverter itself, interconnect capacitances and the thin oxide capacitances of all the gates the inverter is driving.

An important characteristic of the NMOS inverter is that, when the pull-down device is turned on, it not only sinks the current from the capacitive load but also sinks the current supplied by the pull-up load device. This current component from the pull-up device exists even in the quiescent state. As the logic gates spend most of their time in the quiescent state, this quiescent current accounts for up to 90 per cent of the total power dissipated in NMOS VLSI designs; the remaining 10 per cent comprises the switching or dynamic power.

Another important related characteristic of the NMOS inverter is that its output voltage in the low state, VOL, is dependent on the ratio of the impedances of the pull-down and pull-up devices. This ratio affects the noise margin and switching speed and is generally around 4:1. Such a ratio results in a VOL of the order of 0.2 V to 0.3 V. It also causes symmetric switching characteristics, and the fall time of the inverter is significantly faster than its rise time.

The CMOS inverter uses a p-channel enhancement mode transistor as the pull-up device and an n-channel enhancement mode transistor as the pull-down device. Both the pull-up and pull-down transistors are used as switching devices. When the input changes from low to high, the p-channel device shuts off and the n-channel transistor discharges the load. Conversely, when the input changes from high to low, the n-channel device shuts off and the p-channel transistor charges the load. In this case, most of the current from CMOS inverter is used to charge or discharge the load. A very small component of current does not flow through the load. This is due to the fact that both the p-channel and n-channel transistors are on for a short period of time during the input voltage transistion. This current component is typically less than 10 per cent of the total inverter current, although this depends to a great extent on the rise and fall times of the input signal.

Comparing the two inverters (NMOS and CMOS) in the light of the above discussion, it is clear that with no quiescent-power component, a CMOS inverter's dynamic power dissipation represents only a small fraction of an equivalent NMOS inverter's power dissipation. Also, the CMOS inverter is a 'ratioless' design, having only one transistor active after an input transistion. This lets VOL go all the way to ground potential, resulting in better noise tolerance. It is also simpler to design CMOS circuits with outputs having equal rise and fall times. While this is important in some circuits, it is generally not taken advantage of in VLSI designs because it requires greater chip area.

Both the NMOS and CMOS technologies with similar transistor dimensions and gate oxides have identical gate delays. As far as speed power consumption characteristics are concerned, there is tremendous power advantage in using CMOS for high performance VLSI designs. While the CMOS technology enjoys significant electrical advantages over NMOS, it is rather expensive. This is because of the larger number of process steps needed to fabricate a CMOS device and the need for a larger die owing to its lower gate density.

There are four major CMOS technologies in application at present. They are:

(a) p-well bulk;
(b) n-well bulk;
(c) twin tub bulk; and
(d) silicon-on-sapphire (SOS).

Out of these, the highest performing CMOS technology is SOS. In this process, the silicon islands are grown on an insulating sapphire substrate and then n-channel or p-channel transistors are built on the islands. Thus there is significant reduction of parasitic capacitance and, obviously, the performance increases greatly. The SOS technology also offers good gate density because no parasitic bipolar transistors are around to cause a phenomenon called 'latch-up'. But the SOS devices are difficult to manufacture and expensive, largely due to the fact that unused sapphire wafers cost approximately 10 times more than bulk silicon wafers.

The CMOS suffers a cost penalty of about 20 per cent generally due to process differences, but more significantly because of die size. While the processing steps have a linear relationship with cost, die size has an exponential relationship. Actually, CMOS dies are larger than equivalent NMOS designs even when aggressive transistor scaling is employed. There are three main factors contributing to the larger die size—the area used in trying to prevent latch-up, CMOS logic gate structure and static design techniques.

The CMOS can also use dynamic circuitry, especially to increase the ratio of n-channel transistors to p-channel transistors. Since the static CMOS designs have a 1:1 ratio of n-channel to p-channel transistors, increasing this ratio will have the effect of giving CMOS a higher gate density. But the minimum operating-frequency characteristic of dynamic circuitry often conflicts the CMOS potential for absolutely minimising power. Therefore, while true static CMOS design does give the lowest possible power consumption by allowing the device to operate at frequencies all the way to DC, dynamic CMOS designs—being more dense and resulting in smaller die sizes—tend to be more cost-effective. These two trends are developing at considerable rate in the use of CMOS for VLSI microcomputer design.

CMOS is the technology of choice of VLSI microcomputer designs mainly due to two reasons. One is its cost-effective solution to the power-density problem and the other is the reduced supply voltage. Noise tolerance is also better in CMOS at reduced supply voltage than NMOS. CMOS has made, and is continuing to make, major strides in cost advantages relative to NMOS. The designers of the next generation of 16- and 32-bit microprocessors are choosing CMOS. Here the aim is not to operate at the lowest discharges the load and when inactive it lets the pull-up possible power level but rather to keep the operating power under a maximum level for cooler junction temperatures, higher performance levels and the ability to use standard low-cost packages. In these designs extensive use is made of dynamic logic. The ratio of n-channel transistors to p-channel transistors is often as high as 3:1.

Designers of 4- and 8-bit single-chip microcomputers are choosing CMOS to accommodate a host of new portable, hand-held, and ultra-low-power applications. Here the aim is to minimise the operating power levels, consistent with the performance required by the application. In the simpler microcomputers, true CMOS static logic is used; their simpler structure allowing a still smaller die size, while the low-performance applications are appropriate for allowing low operating frequencies. On the other hand, the more complex, higher performance, single-chip VLSI components make maximum use of static logic but are forced into dynamic logic for large arrays to keep the die cost down.

Intel's 80C51 is an interesting example of how the static logic versus dynamic logic trade-off is made in an actual product design. This is an 8-bit, single-chip microcomputer with 4k bytes of ROM, 128 bytes of RAM, two 16-bit counter/timers, multilevel interrupt control, 32 I/O pins, full duplex UART, clock circuits and on-chip oscillator.

The 80C51, CMOS version of the 8051, is targeted at a number of applications that require both high performance and low power consumption. In applications like telephony, automotive control, industrial control and portable instrumentation, the 80C51 operates at or near its maximum speed, even if only for short intervals. For instance, in most of the real time applications, the requirement for external interrupt response time is of less than 100μs; more demanding applications require better than 10μs response time. Though the response must be quick and the interrupt routine executed quickly, the processor spends a significant part of its time almost doing nothing.

It is feasible to specify the minimum operating frequency once we know the performance requirements of the applications. In the case of 80C51, a hybrid static/dynamic design was proposed which allowed a minimum die size and included various modes of operation to minimise power consumption. In the first step, the only areas of the design that were made dynamic were the very large ROM and control arrays. These arrays contained almost 50,000 transistors and constituted a major portion of the die. By making them dynamic, an area saving of approximately 50 per cent could be affected. In the second step, the processor, all the peripheral functions, the RAM and the I/O ports were made static. This type of architecture allowed two modes of operation, other than the normal operating mode. These two modes were termed as power down mode and idle mode.

Since in many applications the processor does nothing more than wait for an event to happen, in the idle mode, the major clocks of the device are stopped and only smaller, ancillary clocks operate to drive the peripheral counter/timers, external interrupt control and the serial channel. When one of the peripherals generates an interrupt, the processor clocks are restarted and instruction execution resumes in the interrupt service routine. This idle mode reduces power consumption by almost an order of magnitude.

In the power down mode, all the clocks inside the device are shut off and only the internal 128 bytes of RAM are 'kept alive'. In this case, only a minute amount of current is consumed due to p-n junction leakage. Static logic was designed in the peripheral sections in order to support this mode because no clocks are available to refresh dynamic logic.

In both the idle mode and power down mode, special provisions are made for the dynamic circuits in the ROM and control areas to enter a pseudo-static condition that prevents any extraneous power consumption due to voltage drift on capacitive storage modes. The 80C51 designed in Intel's HMOS-derived n-well process called CMOS, is less than 10 per cent larger than the NMOS design and consumes only 15 per cent of the normal operating power. However, more significant power savings are possible by operating the 80C51 at lower frequencies or by using the idle mode.

Taking some typical examples, we shall now have an in depth view of the Lin CMOS. The low-power analogue or 'linear' ICs are conventionally fabricated from metal-gate CMOS—a high-capacitance process that yields very low-power operation, but only by sacrificing stability and speed. However, Texas Instruments has now come out with a new development using silicon-gate CMOS process with self-aligned gates which exhibit only 1/7th the capacitance of their metal-gate equivalents. Also, the unavoidable threshold voltage drifts caused by the movement of sodium ions within metal-gate IC transistor structures have been virtually eliminated.

As a matter of fact, Texas has replaced the metal-gates with phosphorous doped polysilicon. This has resulted in the reduction of gate thresholds with changes in time, temperature and gate voltage from millivolts to a few microvolts. This, dubbed CMOS (for linear CMOS), also yields analogue ICs with bandwidths two to three times greater than metal-gate fabricated devices. This has been possible because of enhanced n-channel carrier mobility and lowered capacitance values. By placing NMOS transistors in p-type substrates and PMOS counter parts in n-wells, Texas enhanced the speed of the NMOS transistors. Putting n-channel devices in the substrate gives their carriers almost four times greater mobility over p-channel devices in the same substrate.

In contrast, the p-well approach of metal-gate CMOS results in n-channel mobility only 1.5 times greater than p-channel transistors in the same device. Because the gates in

Lin CMOS processing are formed during the same processing step that forms the source and drain areas, all three elements are self-aligned, i.e., no overlap is needed to ensure alignment as in the case of metal-gate. It is to be noticed that although metal-gate CMOS involves fewer processing steps (eight steps, nine masks), Lin CMOS has only three critical steps to metal-gate's five. Lin CMOS requires 13 processing steps and 12 masks, but reduction in the critical alignment of diffusion, gate oxide, and gate metallisation sharply cuts the cost of fabrication.

Lin CMOS devices were first used in operational amplifiers. While selecting an operational amplifier, a circuit designer is frequently forced to choose among a host of desirable features, extremely high-input impedance, low and stable input offset voltage, single-supply operation, programmable power levels and AC performance. Customarily, superior AC performance is achieved only through bipolar design whereas high-input impedance and low-power, low-voltage operation fall into the realm of CMOS FETs. The majority of operational amplifiers that do provide these performance features are usually constructed as expensive hybrid packages. Delivering all of these attributes on one low-cost CMOS chip as the TLC-271 and TLC-251 is a break-through. There is only one major difference between these two. While TLC-251 is specified to operate from a single-supply voltage as low as 1V, the TLC-271 needs at least 4V between its positive and negative power supply pins. However, both can operate from power supplies up to 16V.

Although several other CMOS operational amplifiers match these chips' high-input impedance (10^{12} ohm) and low-input bias current (1 p.amp. at room temperature), none guarantees against the input offset voltage drift. These operational amplifiers have low offset (typically less than 2 mV), high common-mode range and high common-mode rejection ratio of 88 dB. All are particularly insensitive to gate voltage stresses. Furthermore, these parameters remain constant over long periods of time, virtually eliminating the need for chopper stabilisation techniques which provide the ultimate in DC stability. As a matter of fact, the offset voltage remains stable to within 0.1μV per month at 55°C.

It is apparent that these two chips would be the best choice for replacing currently used operational amplifiers like OP-07, μA-714 or BIFETs OAs. Both TLC-251 and 271 are available in a standard 8-pin DIP and in an SO (small outline) package. A selection and interchangeability guide brochure is available with Texas Instruments which can give a more comprehensive picture to the users of operational amplifiers.

Besides operational amplifiers, the next generation Lin CMOS devices which are bound to find immense popularity among users, would be timers and comparators, of course, to be followed by many more, as listed earlier. It can thus be easily visualised that CMOS technology is best described as the future technology and all future circuit designs would be exclusively based on one variation or the other of CMOS technology. □

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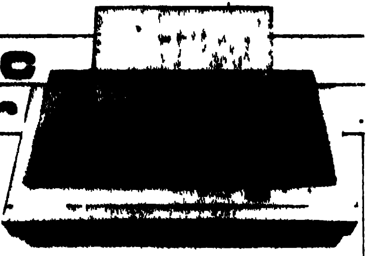

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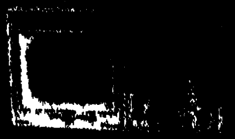

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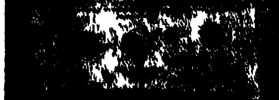

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Microprocessor Control of a Diesel Generator

C.S. Prasanna Kumar

Conventional DG (diesel generator) sets have a panel board comprising contactors, relays, timers, meters, battery charging system etc. Broadly, we can divide this panel board into three parts:

1. Contactor console
2. Metering console
3. Control console

The third part, viz, control console is discussed here in detail.

The control console comprises electromagnetic relays, timers etc. The DG sets are conventionally used as follows:

1. Manually operated single DG set
2. Single DG set operated as AMF set
3. Parallel DG sets, each switching on one after another.

Application of microprocessors: a case study

A 110 kVA DG set with an AMF panel comprising contactors, metering and the controls is selected. The controls are electromagnetic relays. The normal AMF operation of the DG set is shown in Fig. 1.

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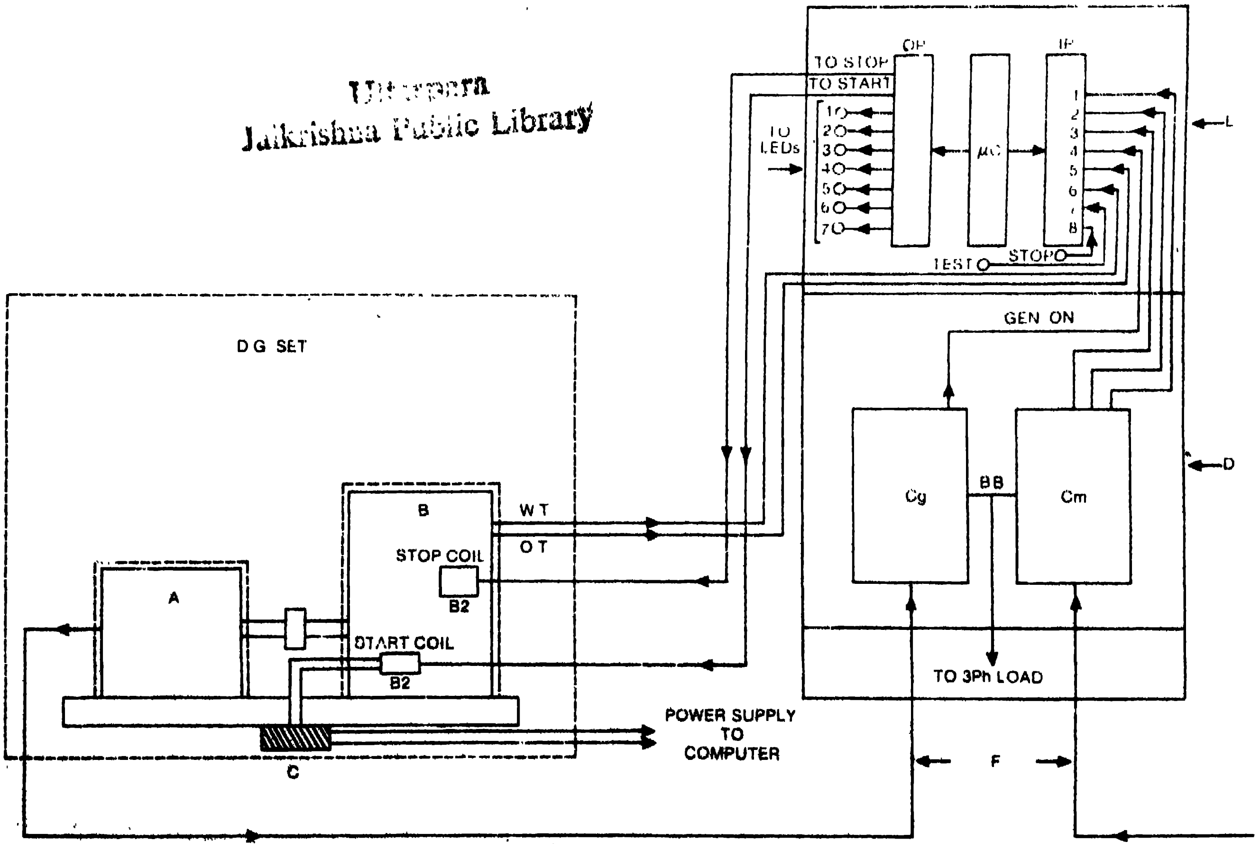

Fig. 1: Normal AMF operation of DG set.

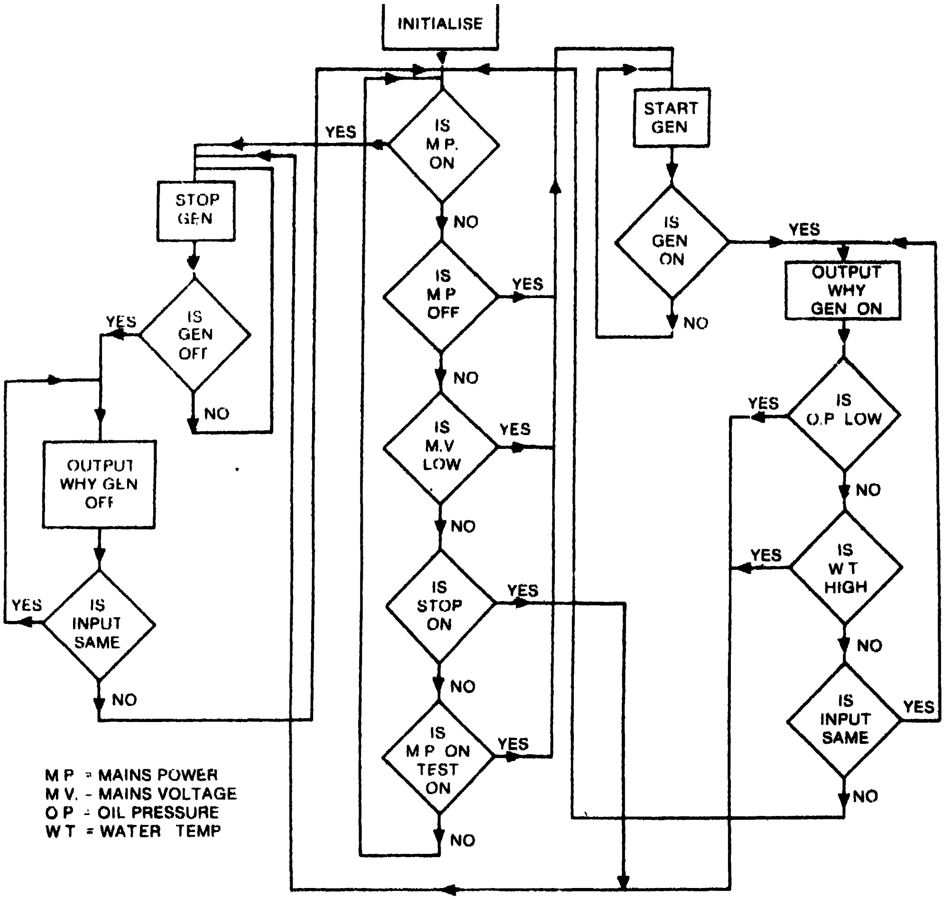

Fig. 2: Flow chart showing the microprocessor control of a diesel generator.

The experimental set-up for microprocessor control is shown in Fig. 2. Here,an Euro STD bus standard PCB glass epoxy card with 8085 chip, programmable peripheral interfaces chips (8255) ROM, RAM, etc are used. The program resides in a 2k EPROM (2716). Input card is a PCB glass epoxy card with optoisolators, buffers etc. Output card is similar but has solidstate relays to which the external system is interfaced.

The set of cards along with the power supply unit is housed in a standard 48 cm (19-inch) Al card cage. The construction is modular in nature. 5V DC supply required for the system is obtained from the batteries.

System functioning

The input information to the microprocessor is digital. Optoisolators in the input avoid interference. The input is latched on through a buffer to the STD bus. The microcomputer card is connected to the STD bus.

The input information goes to the microprocessor which analyses the input information and gives out the output to the STD bus. The output information is latched through the buffers and is available for operation of the solidstate relays.

A logic '1' closes the relay and logic '0' does not operate the relay. For example, to start the generator a solidstate relay connected to the start coil gets the logic '1' as input. Similarly, to stop the generator, a logic '0' signal appears at a particular solidstate relay to operate the 'stop coil'. All the output LEDs are connected to solidstate relays.

Whenever an input status signal appears on the STD bus, it does not operate the output card because it is tri-stated. Similarly, whenever the microprocessor gives out an output condition, it triggers only the output card and the input card is tri-stated.

Result

Upon operating 110 kVA DG set using a microprocessor and an AMF operation, it is found that:

All the conventional time delays for start, stop etc are easily incorporated.

Any variation of time delay is easily done by altering the program.

Comparisons

Microprocessor control of DG is very convenient because the size is very much reduced thus saving space. The system is also superior and reliable being microcomputer controlled.

The cost of the complete panel board including contactors, control and meters is lesser than the cost of conventional panel boards of some leading manufacturers.

Extendability

The idea can be extended to control two or three DG sets operating independently The cost of this will not be very much more In fact a multi-generator control system can easily operate on a single set without any change

For the parallel operation of similar DG sets, the following criteria are essential

1 Equal system voltage
2 Equal system frequency
3 Same phase sequence

The first two conditions are presently attained manually Nowadays, digital phase comparators are available which can be housed in the controller for purposes of parallel operation

Single low-RPM DG sets have other features like crank-case heaters, fuel pumps, cooling towers, compressed air start etc Microcomputer system can be used for such DG sets also

Conclusion

Thus it is seen that microprocessor control of diesel generator is reliable and has a tremendous techno-economic viability

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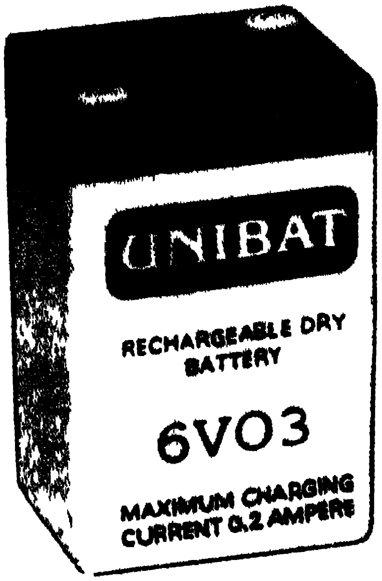

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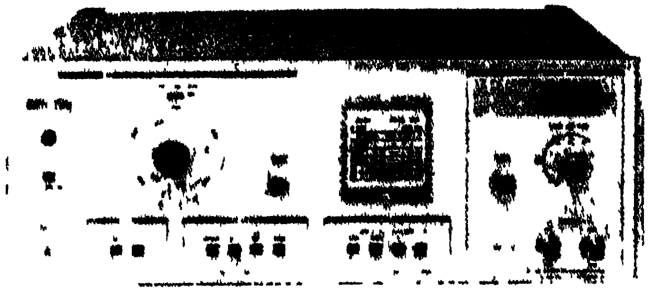

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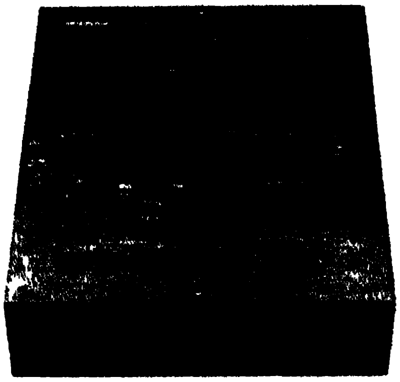

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Are Robots Coming?

Dr N. Vanvari

Many of us have heard about robots being employed to retrieve the 'black boxes' -the CVR (cockpit voice recorder) and the DFDR (digital flight data recorder) - of the ill-fated Air India flight, 'Kanishka', from the depths of the Atlantic Ocean in July '85.

After extensive search operations were launched and called off by navy vessels of various countries, robots were called upon to fathom the ocean. And sure enough, it was the probing robot arm of the SCARAB that retrieved the 'black boxes' from nearly 20,000 metres below sea level!

This amply indicates the role robots are playing now and will play in future, in carrying out humanely impossible tasks.

But before attempting to answer the question, viz, are robots coming, one must have a grasp of what a robot is, how it works, and the advantages and problems associated with its usage.

The word robot was derived from the Czechoslovakian 'robota', meaning, servitude and drudgery. It was popularised in 1920 by the Czech playwright Karel Capek in his play 'Rossum's Universal Roboters', in which humans played as robots.

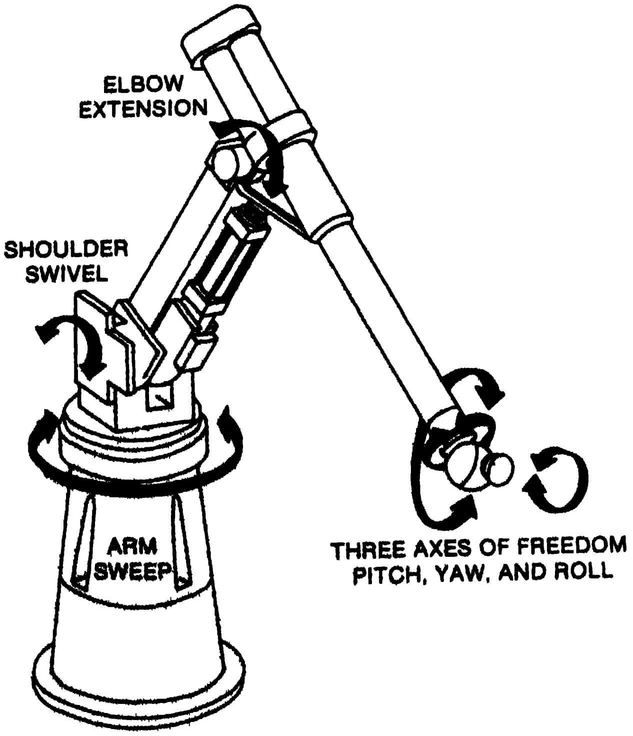
The most widely accepted definition of an industrial robot is that it is a programmable manipulator that can perform useful work automatically without human assistance. CAM-I (Computer Aided Manufacturing International), a manufacturer-user group, defines the industrial robot as "a device that performs functions ordinarily ascribed to human beings, or operates with what appears to be almost human intelligence."

Types of robots

These definitions closely fit modern robots. These manipulators can generally be divided into two classes: sequenced (fixed sequence or variable sequence) and computer-controlled robots. The former employ arms with limited axes. The arms move from point to point. Each of the discrete movements must be recorded in the robot's memory in a sequence. Limited sequence robots include electrically and pneumatically activated arms and are generally less costly than the more sophisticated computer-controlled types. Some can be purchased for as little as $ 5000.

Computer-controlled robots usually employ servo controlled arms with five or six axes of articulations and operate from either electric or hydraulic power. They can be programmed to operate over an infinite number of points that describe the sphere of operation of the robot arms. Such a robot can be taught by an operator to memorise its paths of work in any sequence. They cost from $ 40,000 to $ 60,000 and more.

An advanced robot from Cincinnati Milacron is the T^3R^3 (see figure) which has the same base, shoulder, and upper arm as Milacron's T^3 robot, but incorporates a new wrist design. The wrist on the T^3R^3 is shaped like a sphere, with a diameter of about 20 cm, and consists of three roll axes coincident at a single point. The two roll axes that are



Dr N. Vanvari is deputy general manager, Haryana State Electronics Development Corporation Ltd.

closest to the robot forearm, working in combination, provide 230 degrees of yaw (side to side) motion. The third axis (farthest from the forearm) provides continuous roll for rotation of the tool.

The wrist contains three concentric shafts that drive the axis and are powered by hydraulic motors mounted at the elbow of the robot's arm. The light weight of the wrist provides low inertia for each wrist axis and the remote drive system provides enough stiffness for good servo control. Also, each axis has its own feedback device consisting of a resolver and tachometer for precise positioning. The standard positioning accuracy of the robot is ±0.051 cm.

The types of robot which are likely to dominate the Japanese market are identified as NC (numerically controlled) robots, fixed sequence robots and playback robots. Other types of robots with strong growth rates will be intelligent robots and variable sequence robots.

Applications of robots

One of the oldest industrial robot applications is spray painting. Robot makers like the Binks Manufacturing Co., Trallfa of Norway (distributed in the US through the Devilbiss Co.) and Nordson Corpn, USA, make robots specifically for painting. Such robots relieve human spray painters of an unhealthy task, produce more uniform paint coatings and minimise waste of paint. The largest robot spray painting applications are in the automotive industry. But it is in assembling of components where industrial robots are showing the greatest growth. The trend has been towards small components (typically weighing less than 2.5 kg) in close confinement.

Since robots can be used in many ways, it is conceivable that they may be used to handle explosives, dangerous and harmful materials, high-temperature or low-temperature objects, radioactive materials and so on, under a controlled environment But since the dangers inherent in the use of robots change drastically with the form and mode of the work and other such factors, robots constitute an important safety problem, requiring adequate study before they are put to such applications.

The applications of robots are, however, ever increasing. This is reflected by the fact that Sumitomo Electric Co. of Japan has successfully developed a robot which can play keyboard type musical instruments. It weighs 90 kg, is 180 cm high and has the capability of seeing, hearing and speaking It can operate electronic organs with its hands and feet and can read scores and play likewise.

The human-shaped robot is equipped with arms and legs, has 50 joints and its fingers can work like those of a musician on the keyboard. The robot can strike keys at a high rate of 15 strokes per second and play a variety of music.

The machine is controlled by a system consisting of seventeen 16-bit and fifty 8-bit microcomputers connected to one another by fibreoptic data links with a maximum transmission capacity of 32M bits per second.

The designers developed special engineering techniques to control its complex activities, sophisticated fibreoptic data transmission methods to permit high-speed action and new structural materials to make it light. The machine can recognise registered vocal commands from an operator and respond in a synthesised voice consisting of independent syllables combined into smoothly pronounced words and sentences that sound natural with controlled rhythm.

Robot sensing systems

There is constant debate about whether a robot should have tactile sensing or vision sensing, or both. Vision and tactile sensing serve specific purposes. Vision is good for parts indentification and acquisition, whereas tactile techniques are better for parts insertion. So robots can use both types of sensing.

With the moves to increase automation of factories, development of robots, especially intelligent robots, has drawn keen interest from industry. Control systems and mechanical technologies have led to advanced robot capabilities. But for taking robots to a more advanced step in which they can move on the basis of the work to be done and the environment of the workplace, rather than simply following preprogrammed instructions, sensors will be indispensable. Visual sensors are among the most important for more advanced robots.

With visual sensors, recognition decisions are performed in a preprocessing unit that draws the essential information from image data obtained by using a camera to form the basis for a decision within predetermined parameters. On the basis of these parameters, the main processor makes the final determination and the controller drives the movement of the system.

Visual recognition systems takeover from humans in three basic functions, viz, discrimination, position and orientation detection, and inspection.

A useful application of robot visual discrimination technology is that of pin-picking and recognising objects one by one. The separation of objects in an orderly manner, clearly divided visually from large to small, makes it possible to use a standard robot visual system. However, there are problems when objects are jumbled together or when they adjoin or overlap each other. This is an interesting field for future research.

But, when metal bars are piled indiscriminately, it is possible for a visual system to distinguish them by taking advantage of the fact that their surfaces shine if light is flashed at the edges, giving off a brighter image. Then, discrimination is done by analysing time pattern of reflection. Discrimination by this method is nearing practical application.

For inspections that do not involve precise eye-to-hand coordination, much of the current vision technology is usable. Colour vision can spot a fruit that's ripe for picking, while infrared sensors are good at detecting potential sources of disease before a crop becomes infected.

A number of improvements in vision and light-sensing devices for robotic equipment may increase their range of application. High resolution solidstate imaging devices have reduced the cost of getting scene information into digital form; and falling prices of computing power and main memory have aided vision input just as they have aided visual display.

Examples are the MVS 100 vision system of Perception Inc., Farmington Hills, Michigan, which can recognise parts on an assembly line and initiate different operations for each part; the RV 600 of Automatix Inc., Burlington, USA, which can track and inspect welding seams produced by a robot welder; and a printed-circuit board inspection system based on pipelined image processing architecture developed by the Environmental Research Institute of Michigan, Ann Arbor,and the three dimensional imaging system using multiple cameras for parts inspection and quality control developed by the General Motors Corporation.

Thus far, however, vision systems still fall short of human abilities (function of human eyesight) by several orders of magnitude.

Installation, preparation and adjustment

Most of the robots have a centre of gravity that is not at the centre of their body and which changes according to the position of their arms. These robots cannot stand upright until they are anchored on to a platform with bolts. Robots are very unstable during transport and are very difficult to handle if the arms are not locked. These stability factors should be considered whenever industrial robots are to be moved for installation.

The adjustment and positioning of the limit switch, shock absorber, brake and other elements to instal a robot in its working position sometimes requires people to work in high places. This kind of above-the-floor workplace to set a robot into position is not frequently seen in factories using conventional machines and can therefore be considered peculiar to working with robots.

Operations to change the hand-grasping element or connecting the robot to form a system with other machines, or to instal a guard fence may not seem to be much of a problem when they are performed with the power supply to the robot turned off. Whereas, operations such as gain adjustment, offset regulation or auxiliary circuit regulation to make the fullest use of robots, must be carried out with power supply on.

When a work sequence performed by a robot is to be revised, the pre-recorded cassette tape must be re-recorded or replaced after the new work sequence has been programmed. This work includes confirmation of whether the new program called for has actually been set.

Programming is the work of preparing in advance, the sequence of operations to be performed by the robot. Various systems are available: (i) programming by numerical control language, (ii) pinboard method, (iii) combination of potentiometer and sequencer, (iv) teaching box, and (v) direct teaching by actually moving an arm of the robot. These methods involve control of movements of the very powerful and potentially dangerous arms. Specially, the teaching box method of robot programming is a job involving a close human-robot relationship, in the sense that the robot is taught its work by numerous pushbuttons operated by a human. This teaching work poses peculiar problems concerning the safety of the workers.

Supervision and testing the robot's performance, involving the 'check' and other functions, is conducted at low speed, or with no work load, or with no electric current flowing in the welding wire in arc welding robots, because it is impossible to fully test the programmed robot operations by simply switching them to automatic operation mode. Test sequences involve correction of errors and regulation of electric current or hydraulic pressure. A close human-machine relationship is formed in this test operation work in the sense that the eyes of the operator must be keen to determine with accuracy when the robot is moving at a steady speed.

Before a robot can be used, various set-up operations must be performed: turning on the power supply and the oil pressure pump and manoeuvering the robot arm back to its starting position. Then, the automatic sequences to check the oil pressure, oil temperature, abnormal start and other steps related to the initial operation of the robot can be checked to determine that the robot is in the condition of 'preparations completed'.

The robot is then ready to be switched over to 'automatic' operation and started. When performing these steps, it is important to confirm with certainty that there is no dangerous condition within the operating zone of the robot, as past cases of accidents have clearly demonstrated that a careless or haphazard approach to the set-up procedures is an invitation to disaster.

Protective measures

All kinds of accident-prevention measures should be taken. Among the physical devices and equipment that should be installed are safety fences, safety plugs and mechanical brakes. Sensors to detect the presence of human workers such as photoelectric, electrostatic, ultrasonic, laser and visual monitor sensors, as well as machine malfunction detectors, should also be employed. The construction and function of each of these instruments need more research. Considerably more engineering reviews need to be done to design adequate safety measures into manufacturing facilities where industrial robots are used in large systems to form wholly automated assembly lines.

It is important to thoroughly educate operators, programmers, maintenance and repair engineers as well as part-time workers, on appropriate safety precautions such as guiding them to be away from the danger zones of robots.

Reliability of industrial robots

Failures of the electrical circuits, including the microcomputer, account for the largest number of robot breakdowns, and malfunctioning of jigs and other instruments account for next largest share of robot trouble. Runaway, an unreproducible erroneous action, caused by short-circuits, noise or similar interference, at 11.1 per cent, is by no means a small portion of the total robot trouble statistics.

The mean time between failures (MTBF) is rather high: 75 per cent of robots have an MTBF of 1000 hours or less and those with an MTBF of 100 hours or less account for 28 per cent.

Some robot manufacturers claim that robot reliability has been greatly improved lately. But even with improvement, the best MTBF achieved has been 2500 hours. When robots are incorporated into systems with other machines, they inevitably become machines with a considerably higher incidence of troubles. Under such circumstances, it should be fully recognised that robots have not yet attained adequate reliability.

Market trends in robotics

According to a study, the utilisation of industrial robots was generated by the oil embargo of 1973. With the necessity to save energy as the background, the production trend has been changing from mass production to small quantity output of a variety of industrial products. Consequently, the totally automated factory, equipped with a variety of robots, has become a reality.

Robot sales in US totalled $ 234.9 million in the first nine months of 1984, surpassing the $ 194.4 million in sales tallied for all of 1983, according to the Robotic Industries Association.

The European market for industrial robots will reach $ 572 million by 1986, as high labour costs, declining productivity and fierce international competition increasingly pressurise companies to automate. Although the robot 'boom' that has occurred in the United States has not reached Europe, the market is rapidly gaining momentum.

The increasing abilities and declining costs of robots make it a particularly attractive investment, and the European market for robots is attracting capital and new competition. Over the next five years, the market is expected to grow at compound annual rate of 58 per cent.

The highly labour-intensive assembly application will exhibit the most dramatic growth through 1986, at a compound annual rate of 80 per cent. Assembly work is ideally suited for robots and this application may come to be the dominant sector of the European robotics market, in terms of units installed. With high unemployment rates, however, job security has become a major union issue and union resistance to robots—especially in assembly tasks—is likely to increase.

Health and safety regulations also play a key role in market growth. Although there is no uniform approach among countries, most are under increasing pressure to improve working conditions, fuelling the growth of robot use in applications that are hazardous or unpleasant for workers.

Robots are coming

Robotics is already an important part of the overall factory automation, particularly in Japan and in automobile production world-wide. But the greatest growth in this field is yet to come. At present, the US is far behind the rest of the world in installed robots. For example, there are about 12,500 robots installed in Europe, 140,000 in Japan, but only about 8000 to 9000 in the US. According to some predictions Japan is likely to have nearly one million robots by the year 2000.

USA has now joined the race and is introducing robots in the agricultural field. Robots checking crop growth, harvesting fruit, planting tissue-cultured seedlings, fumigating, cultivating, or milking will soon become a familiar sight in the US.

Robots are proliferating in heavier industries, as well as other fields including military applications. Artificial-intelligence-based military and paramilitary robots for applications ranging from battlefield service to sentary duty may pass $ 500 million mark, according to the Internation Resource Development Inc., USA.

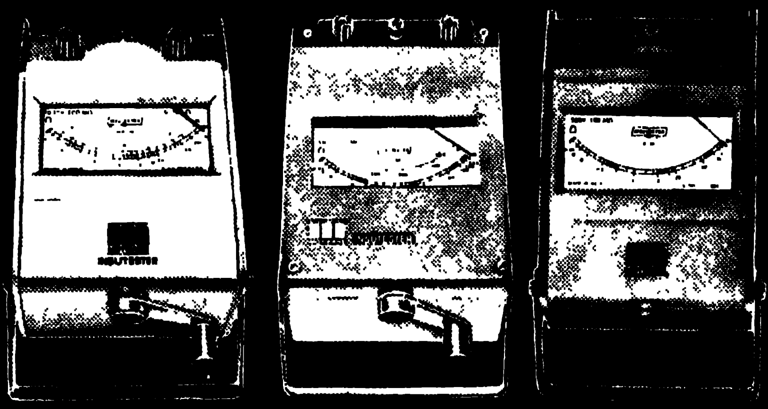
The benefits of robotics are now well established: increased quality, higher productivity, and high reliability of products manufactured with the help of robots. But considerable work still lies ahead in robotics, specially in software development and support functions. Eventually, robots will be linked directly with networks linking various computers. New sensors for vision and tactile feedback are being incorporated in order to make true assembly robots feasible.

Artificial intelligence techniques are also being coupled with robots for taking into account unexpected events such as tool breakage or a robot gripper dropping a part. Simply sequenced robot motions may cause disastrous results unless such possibilities are taken into account.

However, marriage of robotics with microprocessors and other semiconductor devices has already taken place and is leading to the development of 'mechatronics' techniques. With application of these techniques, robot is no more "a passive, stupid machine that deteriorates rapidly under load" and, therefore, will clearly play a greater role in future automation, space exploration and 'star-wars'.

Now, the question that remains to be answered is "will robots come to India, a country having labour-oriented economy?" Answer is probably "yes". But, robotics will be useful for India if it is kept confined to areas where the going is hazardous for human worker. ☐

Always a move ahead



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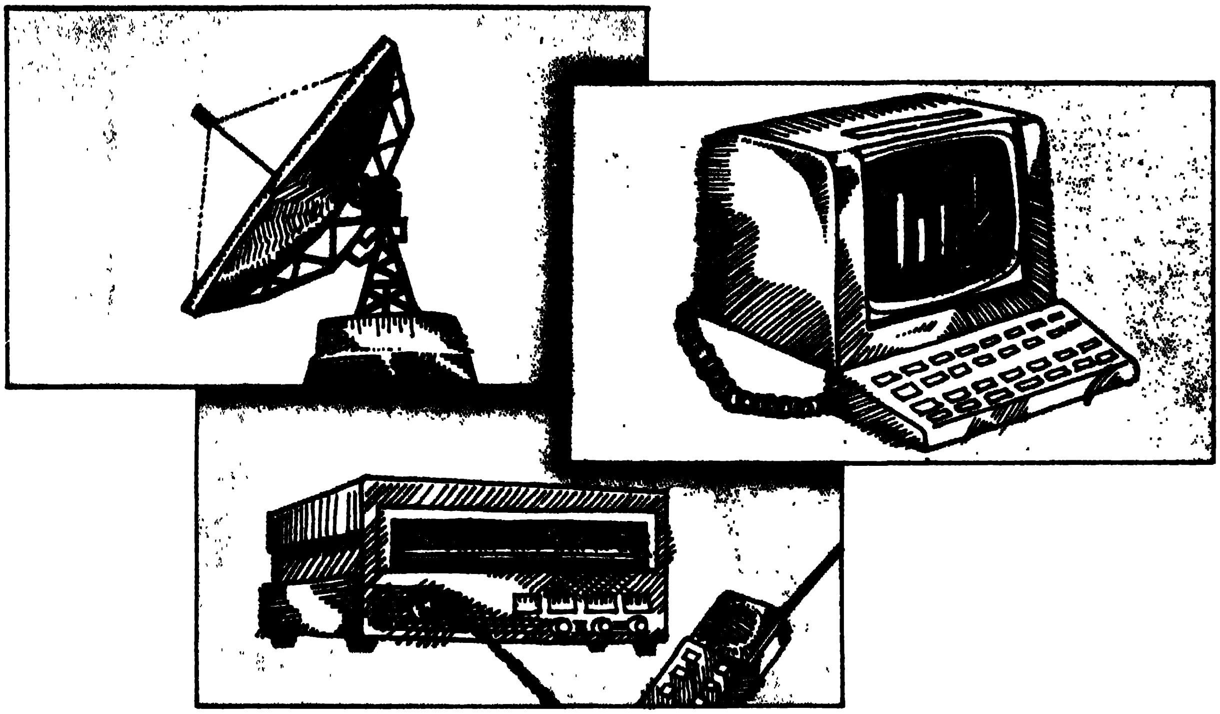

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Czechoslovakia: The Electronics Boom

Antonin Filip

In recent years, electronics has registered the fastest growth rate among Czechoslovakia's industrial branches. While in 1984 the overall industrial production rose by 3.9 per cent, electronics recorded a 12.2 per cent increase. This growth rate indicates that in the seventh five year Plan period (1981-1985), electronics production could grow by as much as 50 per cent.

The dynamic growth of electronics in Czechoslovakia has been affected by the fast-increasing manufacture of electronics components and growing supplies of computer technology, communications equipment such as telephone exchanges, radio and television transmitters, and consumer electronics products. To illustrate the point, let us mention that between 1982 and 1984 Czechoslovakia's production of digital computers increased from 322 to 1080 units and of colour TV sets from 71,000 to 142,000.

Competent authorities in Czechoslovakia view electronisation as a major instrument of the qualitative restructuring of the national economy which makes it possible to improve production technology, extend automatic processes, utilise robots and raise the utility value of manufactured products—machinery, production equipment as well as consumer goods.

Experts predict that as early as in the late 1980s it will be possible to introduce electronic systems in 120 out of the 448 production branches in the national economy, in which between 5000 to 6000 practical applications of electronics can be made. It is expected that in the coming years ten to 20 per cent of energy can be saved in this way while significantly raising the productivity of labour. Further, these changes are expected to save up to 300,000 jobs while the workers concerned will find employment in other branches which are currently under-staffed.

One of the key problems confronting the development of electronics and its practical application in Czechoslovakia is that many electronic devices and systems produced in initial small series are too costly to allow mass production. That is why in 1984 Czechoslovakia introduced a dual-pricing system of microelectronic circuits. Higher wholesale prices are paid by manufacturers of components to fully cover costs and to ensure adequate profit. On the other hand, lower prices are paid by consumers which makes it possible to apply electronics in machinery and equipment.

This price differentiation has remarkably stimulated demand for microelectronic circuits. Contrary to originally forecast growth of deliveries by 9.5 per cent in 1984, manufacturers of these devices had to raise production by 21.9 per cent, and in 1985 the production increases were raised from 24.8 per cent to 53.1 per cent.

Following price reductions of some consumer electronic components which came into effect in the past years, in the beginning of 1985 the wholesale prices of some final products were adjusted. The prices of the basic units of the EC-1026 computer and the SAPI-1 microcomputer system were cut down by 29.8 per cent. The price of the EC-7039 line printer which serves as an output for computers also dropped by 8.9 per cent and is expected to lead to a faster expansion of computer technology.

Wholesale prices of some automation and regulating equipment were also reduced, and the prices of control systems used in various machinery and equipment went down by 16.9 per cent to 35.1 per cent. For instance, consumers now pay 26.7 per cent less for the ADT-4500.2 computer. All these price reductions are designed to pave the way for the introduction of automation and regulating devices on a mass scale.

In view of Czechoslovakia's restricted domestic energy resources, great attention is accorded to economical utilisation of all kinds of fuels and energy. Until recently, efforts to save energy in public and industrial lighting ran up against the obstacle of relatively high prices of sophisticated energy-saving illumination sources. This problem was also taken into consideration in the adjustment of prices of electronic equipment.

As of the beginning of 1985, socialist organisations and enterprises pay 42 per cent less for 40W fluorescent lamps, 49 per cent less for 100W mercury discharge lamps and 210W sodium vapour lamps and as much as 57 per cent less for 250W sodium vapour lamps. These price reductions are also expected to provide a fresh impetus for the replacement of existing lighting equipment with more energy-saving sources.

These reductions of the prices certainly do not represent the last step taken by electronics producers. In the coming years, this industrial branch is to broaden its dual-pricing system to cover other groups of products. □

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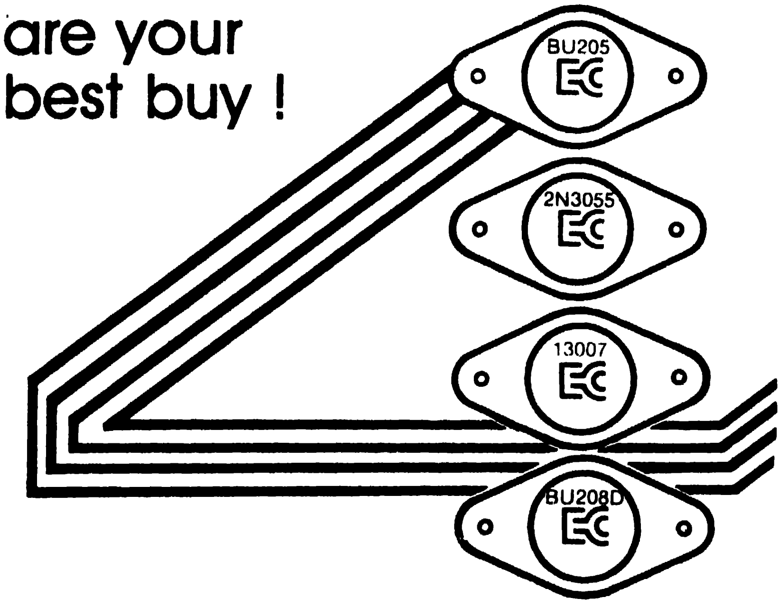

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GT	Go until breakpoint
MM S/D	Memory Modify/set/Display
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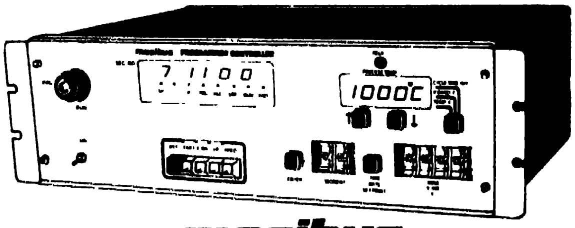

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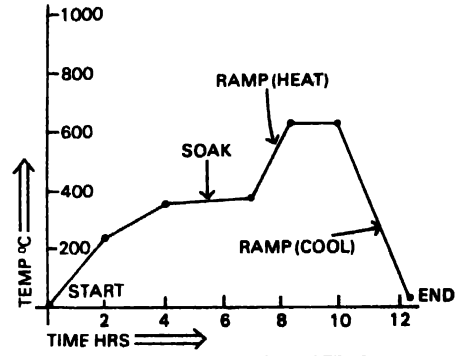

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Computer Corner

Course assessment and performance system

The managements of training institutions/schools/education boards/colleges/universities/competitions conducting bodies like UPSC etc, often find cumbursome and time consuming the task of finalising the results of students/candidates or monitoring the performance of the class during its conduct. The problem is more than aggravated if their number is very large.

For the first time in the country, a Course Assessment and Performance System [CAPS] implemented on a local area network [LAN] consisting of a mass storage from Corvus Systems, Inc., USA, and Apple or Apple-compatible microcomputers has been installed at the Military College of Telecommunications Engineering [MCTE] solve this problem.

Without any modifications, the system can also be used in stand alone mode with an Apple/Apple-compatible computer system having a hard winchester disc and only one flexible disc drive with CP/M operating system.

CAPS is a user friendly, interactive system, which accepts users' answers from the keyboard, in response to very simple and easy-to-understand questions which it displays on the screen.

Optical disc computers

A way of using pulses of light instead of pulses of electricity to carry messages in computers could be reality for researchers at Edinburgh's Heriot Watt University.

For, the first experimental optical computer is expected to be ready for testing there in late 1986. A research team under Professor Desmond Smith, a world leader in methods of using optical components in computers, began work on the project more than five years ago.

The team has shown the type of optical components from which complex computers could be built using devices that are the optical equivalent of transistors. The components are called transphasors.

The advantage of optical computers is that such machines, if perfected, could work thousands of times faster than the best electronic ones and they could process data in important new ways.

The increase in speed is made possible because light does not suffer the disadvantage of electrons which are slowed to a few per cent of the speed of light in silicon microchips.

A total of over 2000 optical disc filing systems have so far been installed in Japan since the first system was installed in 1982 to work as a document filing system. The discs range in diameter from 20 to 30 cm. The storing capacity, which depends on the disc size, is generally very large, the average disc being able to store between 15,000 to 60,000 A4 pages of information.

Computer units record 218 per cent growth

The centre's move to liberalise the computer policy seems to have paid off handsomely. The computer industry of India, yet in its infancy, has recorded a breathtaking 218 per cent growth rate for the year 1985.

In monetary terms, the growth rate recorded stood at an astounding 78 per cent.

Disclosing this at a seminar on 'computers in Indian management-an update', in Calcutta, Dr N. Seshagiri, additional secretary in the Department of Electronics [DoE], said 'the DoE was trying to convince the government to lift the many controls on computer technology import.'

Applauding the achievement of the computer industry, Dr Seshagiri said 'the achievement would assume greater significance seen in the backdrop of a 40 per cent fall in prices of computers.'

Dr Seshagiri believed that the industry was capable of maintaining at least 100 per cent growth rate in the future.

Supercomputer for India?

A top-level team of Indian computer experts from the DoE visited the Control Data Corporation's headquarters at Minneapolis to evaluate the US supercomputer to determine its usefulness for India's requirements.

The visit came off as a result of an invitation from the manufacturers of the supercomputer. The Reagan Administration also sent an official to Minneapolis to observe the developments which are likely to bring New Delhi and Washington to the last phase of talks on the proposed sale of the world's most sophisticated computer.

Though there are some indications that India may be able to acquire the super computer, the Reagan Administration has not yet disclosed its stance officially.

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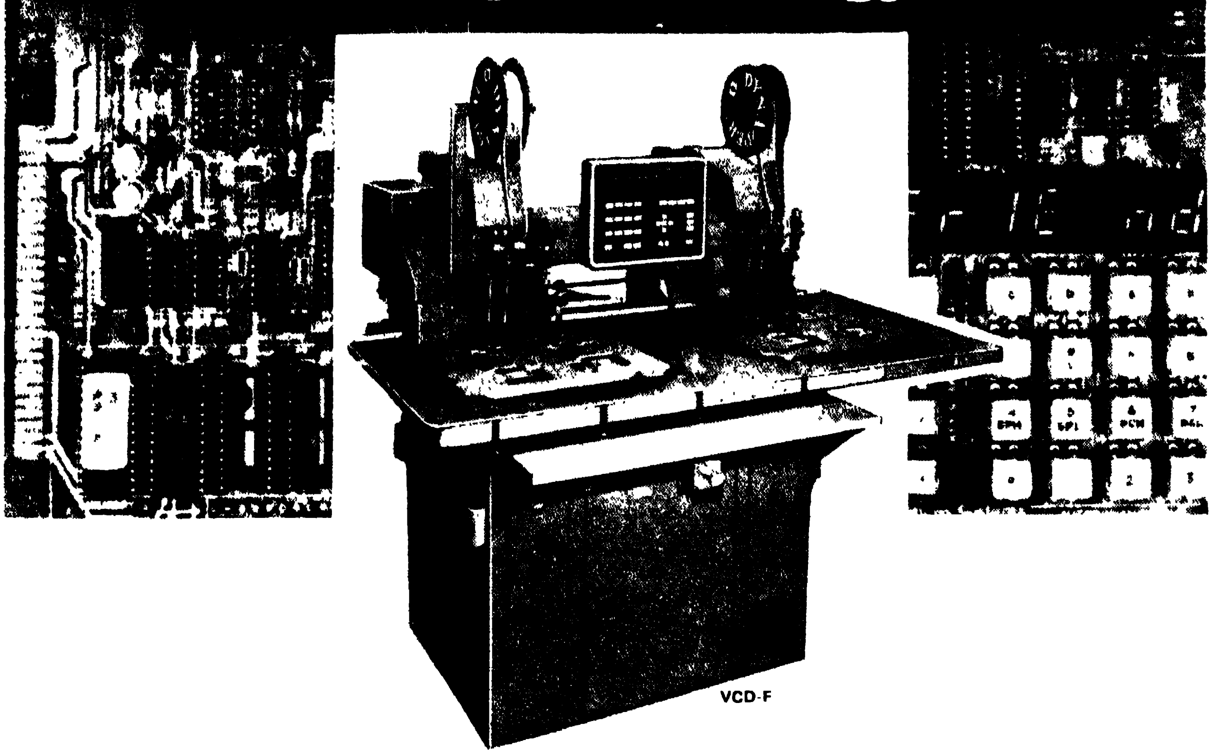

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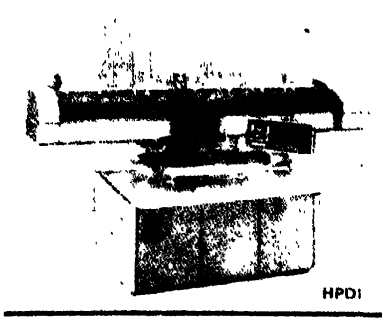

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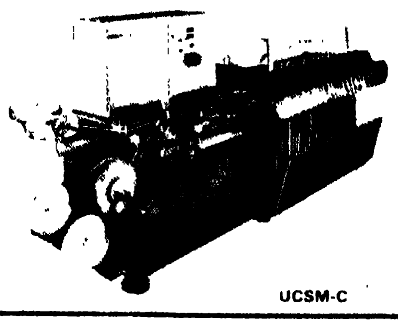

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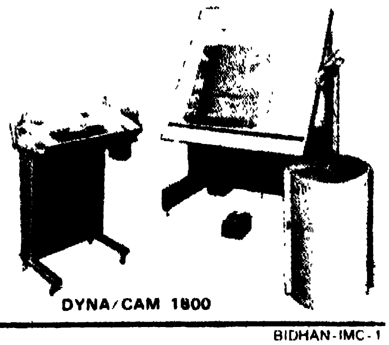

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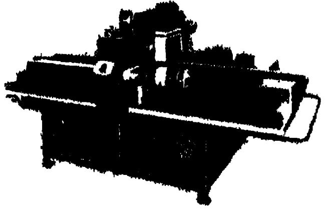

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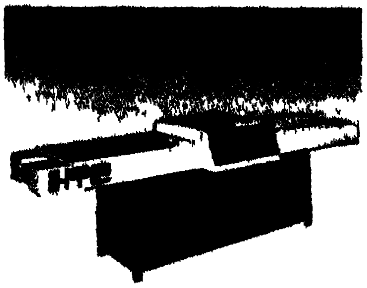

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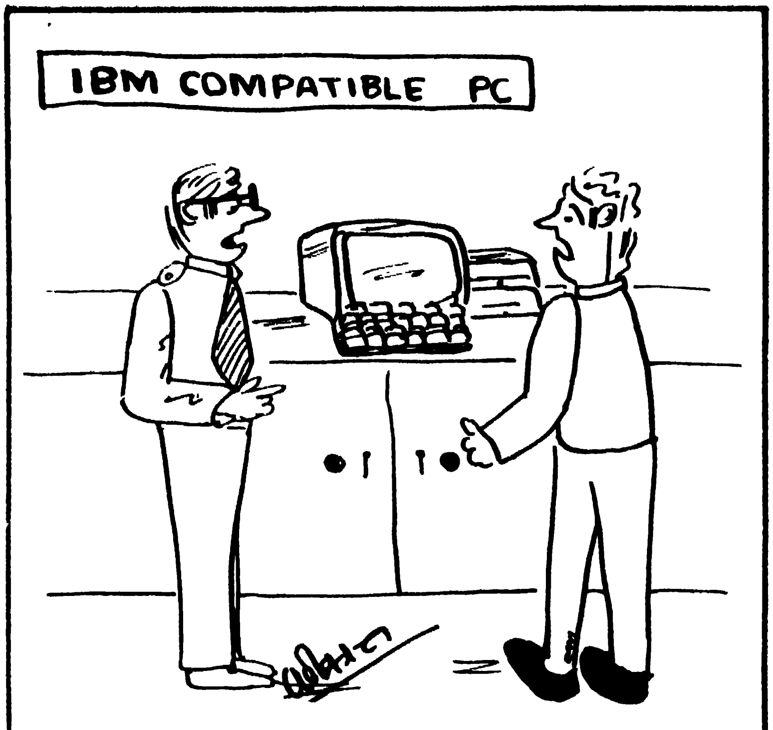

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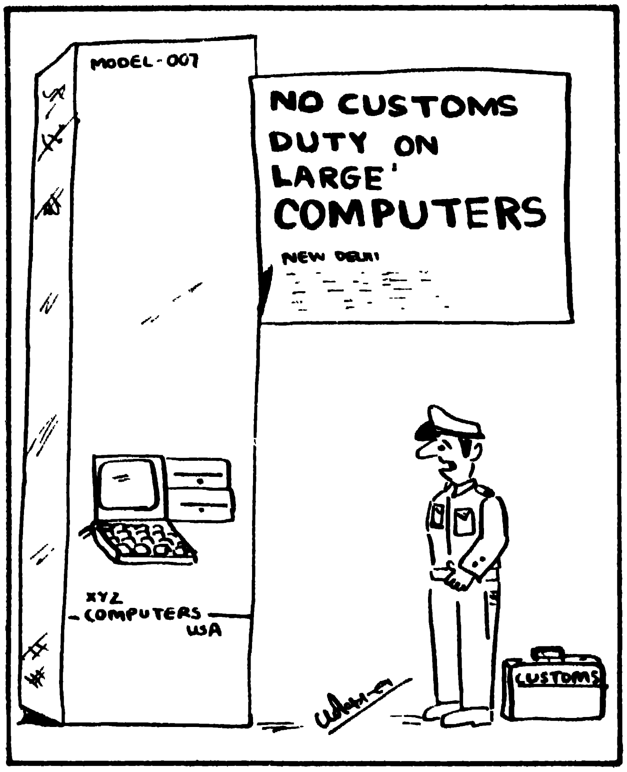
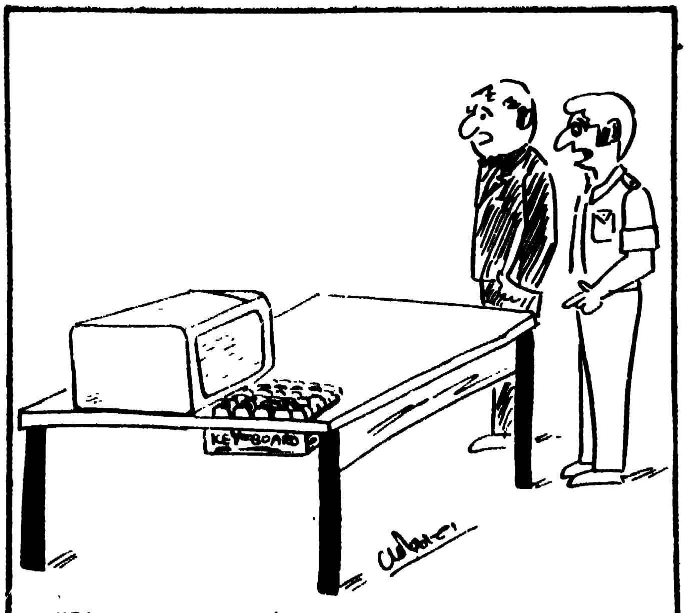
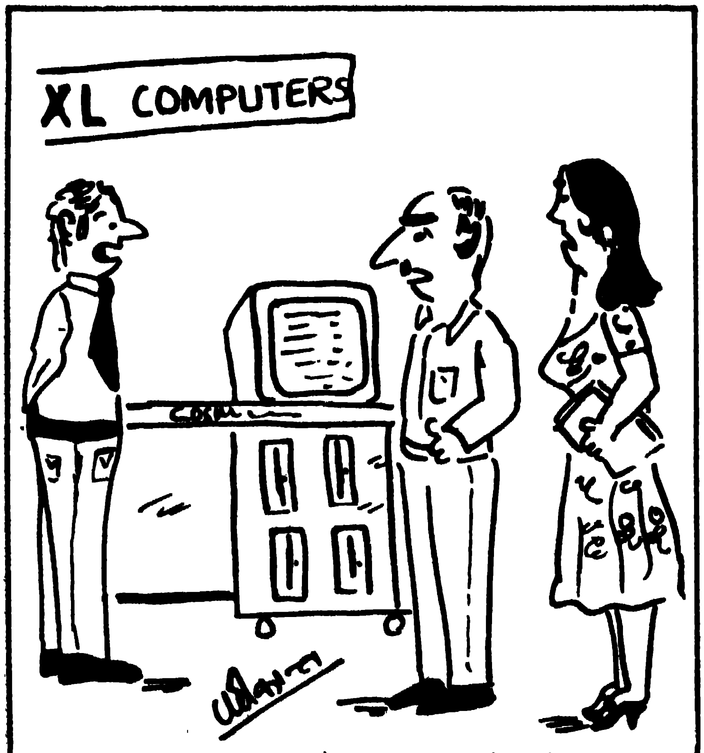




"Sir, our new microcomputer with very low profile keyboard."



"In fact, our computer does not require airconditioning, but your secretary may..."

Principle of Moving Head Disc

S. Batra

In every computer system there is a main memory. This normally comprises of semiconductors, i.e., IC's or ferrite cores (introduced in the recent past). Every computer, depending upon its capacity, provides certain amount of main memory (MM). If the capacity of the computer system has to be increased, obviously the size of the MM has to be increased.

It is not economical to increase the size of MM beyond a certain limit. In such cases, other peripheral devices are used to augment the MM capacity. They behave as a part of MM and their performance characteristics are very similar to that of MM for all practical purposes. Various peripheral devices used for such purposes are magnetic tape drive, fixed head discs and moving head discs.

For reasons of large storage and reasonable access-time, moving head discs are very commonly used in the medium and large computer systems. They provide large storage capabilities with moderate operating speeds. A variety of magnetic drives are now available. Although differing in specific details, all of them are based on the same operation principle.

One or more rotating discs coated with magnetic material are stacked one above the other with some space between each disc. Information or data is recorded on the surface of the rotating discs by magnetic heads which are positioned against the discs. Unlike the music records or discs, the information is not recorded in a spiral but in bands. Each band of information around a given disc is called a 'track'.

Major assemblies

Major assemblies of a typical disc are shown in Fig. 1. They consist of linear positioner, air system, read/write heads, drive system and disc.

Linear positioner. It consists of the linear motor, the carriage and the read/write heads. To move the read/write heads across the recording disc, DC current is applied to the

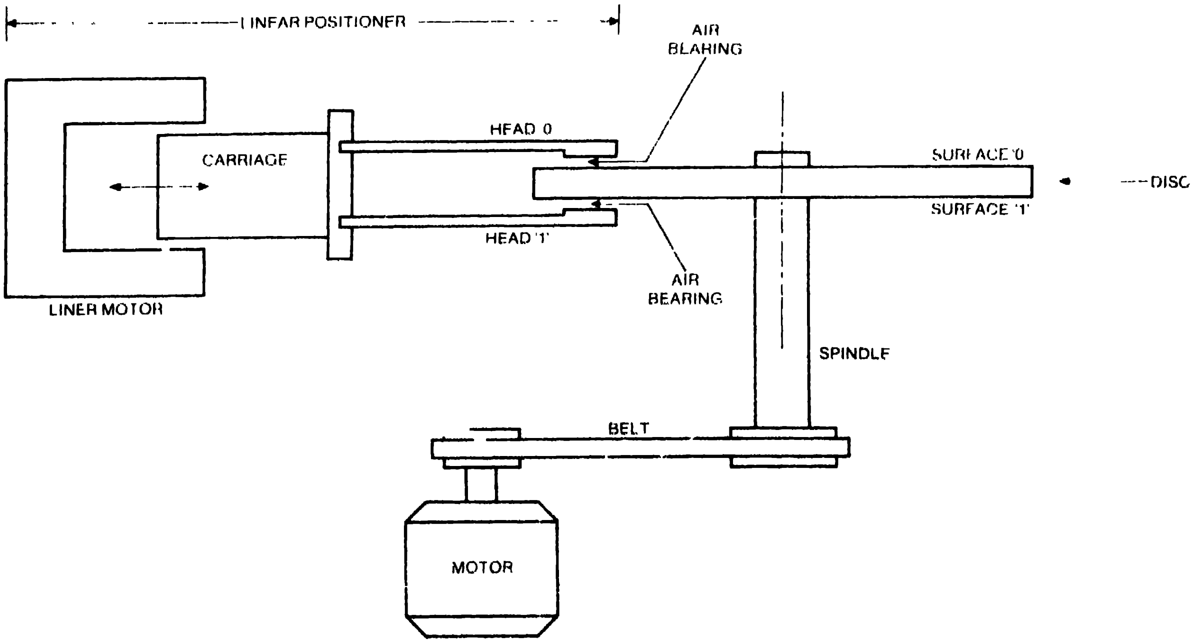


Fig. 1: Simplified diagram of a single disc drive.

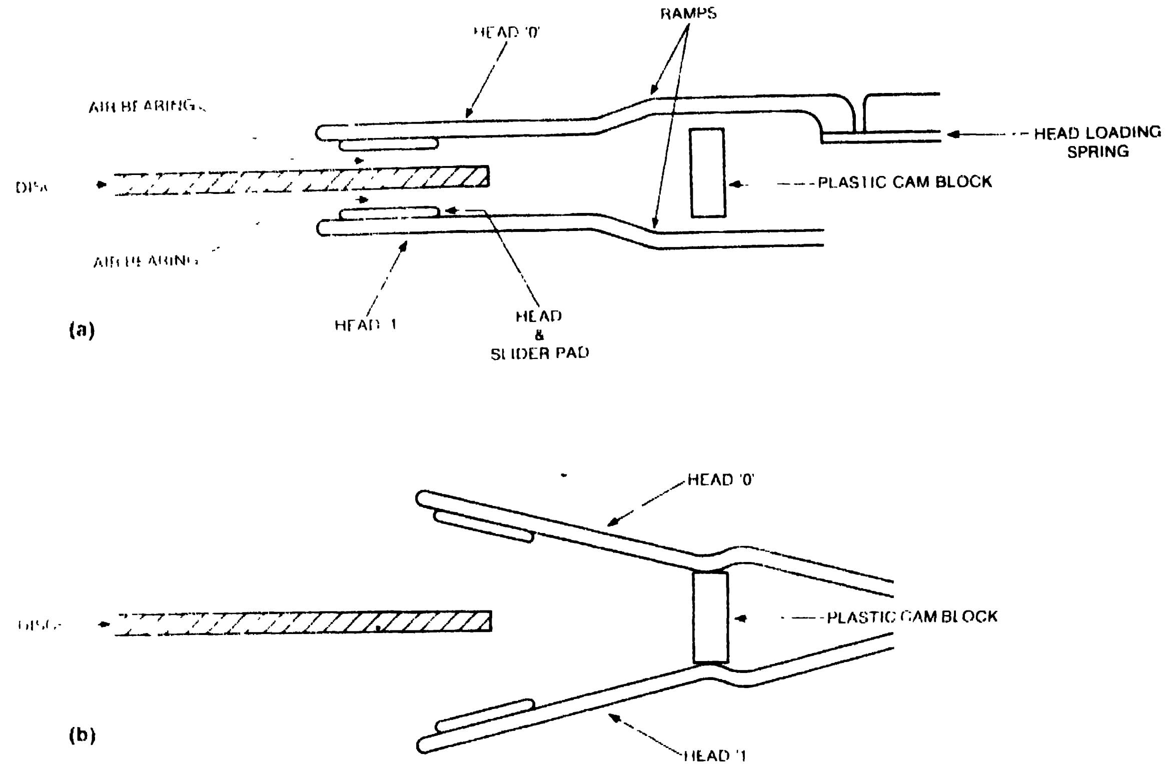


Fig. 2. Single disc head assembly: (a) head loaded, (b) head unloaded.

bobbin-wound armature of the linear motor. The resulting magnetic field reacts with a permanent magnet in the motor-housing to either pull the armature into or force it out of the permanent magnetic field, depending upon the polarity of the current applied to the armature. This motion is transferred to the carriage, which is fastened to the armature. As a result, the R/W heads, which are attached to the carriage, move across the surface of the disc.

Air system. The air system has a blower. It passes the air through a filter where even minute contamination is removed. The purified air is taken to the disc over which the R/W heads move across in the air. The R/W heads do not touch the surface of the disc. Contact with the surface spoils the oxide-coating on the disc.

Read/write heads. One head functions on the top surface of the recording disc and the other functions on the bottom surface. The heads are mounted on the suspension arms that rest (when the heads are unloaded in the disc) on a plastic cam block or duckbill (see Fig. 2). Flat cantilever springs connect the suspension arms to the head-support tail pieces. When the drive (moving head disc) is placed in run mode, the positioner moves the heads forward towards cylinder zero (outermost). When the entire head slider pad has passed the edge of the disc, a ramp on the suspension arm slides down the edge of the plastic cam block thereby moving (loading) the heads close to the disc surface. As many R/W heads as the total number of surfaces are used and mounted in a comb-like arrangement as shown in Fig. 3.

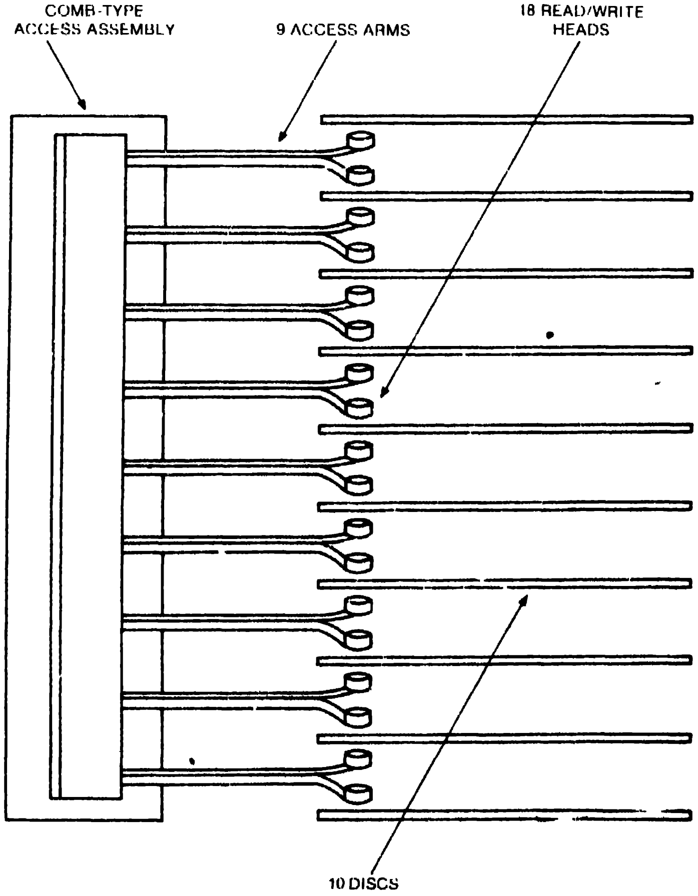


Fig. 3: Multiple disc/head assemblies.

When loaded, the heads 'fly' about 30-100 microns from the disc surface. A film of air (air bearing) between the disc and the head exerts a force away from the disc while the cantilever spring acts as the counter-balancing force towards the disc. Thus, as long as the disc rotation remains constant, the heads remain at a relatively constant distance away from the disc surface.

Each head is a 4-terminal magnetic device containing two coils (see Fig. 4). A centre-tapped coil performs the read or write function while the other series-connected coil performs the erase function. The head is designed so that the erase coil is electrically connected to the centre tap of the R/W coil and is energised whenever a write operation occurs. This type of head configuration called 'straddle erase' erases most of the residue from prior recording between the tracks and thus eliminates track 'cross talk' or interference from such recording.

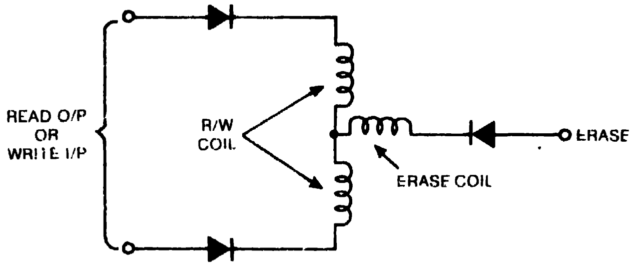


Fig. 4: Simplified diagram of read/write head

In a typical moving head disc having 400 tracks/surface, data tracks are 0.1mm (0.004inch) wide with 0.025mm (0.001inch) erased separation bands. During a write operation, current through the write-coil automatically overwrites old data.

Drive system. The motor drive system consists of a spindle, belt, motor and recording disc. The motor is generally mains-operated split-phase which drives the spindle pulley through the drive belt. The speed of the motor also decides the 'access time' of the disc. Faster the speed, lesser the access time. The spindle-speed is held constant through a servo system in the disc drive.

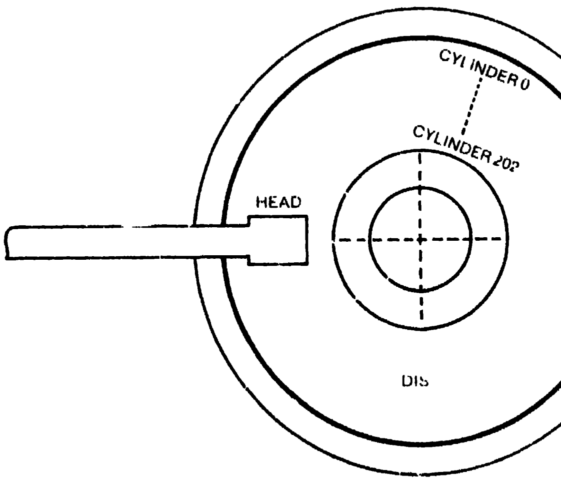


Fig. 5: Surface of a typical disc

The disc has a very fine (30-100 microns) coating of ferrousoxide on a suitable base (as shown in Fig. 5). A typical disc has a radius of 17.8 cms. The area within about 7.5 cms from the centre is required for hub-mounting and 5 to 7 cms from the outer side for data recording. The disc surface may have 12, 16, 18 or 22 sectors (as shown in Fig. 6). Each sector may contain 256 or 512 words in every track.

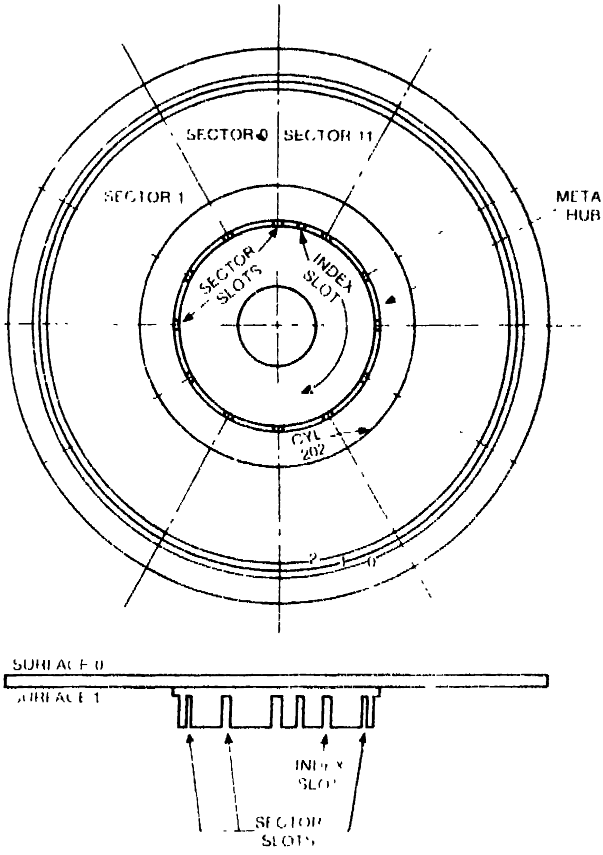


Fig. 6: Plan and elevation of a disc.

Sector is defined by a slot called sector slot. These sector slots when sensed by a photosensor generate pulses from the disc drive to the controller. Another similar slot called index slot (detected by different spacing length) defines the starting point for the sequence of sectors.

Recording technique

The Recording head is a coil-wound ferrite core with a gap. As current flows through the coil, the induced flux magnetises the surface of the disc passing through the gap. During a write operation when the current direction in the coil is reversed, a flux reversal is recorded on the disc. During the read operation, the previously recorded flux pattern on the disc induces current in the head. Any flux reversal on the recording surface produces a pulse.

The most commonly used method of recording is double frequency NRZ (non-return to zero) method of magnetic recording. In this method, flux reversal (see clock pulses in Fig. 7) are recorded on a magnetic disc at regularly spaced intervals. The time period between these clock pulses is a bit cell and data storage occurs within these cells. A flux reversal during a bit cell represents a logical 1. The absense of a flux reversal during a bit-cell is a logical 0.

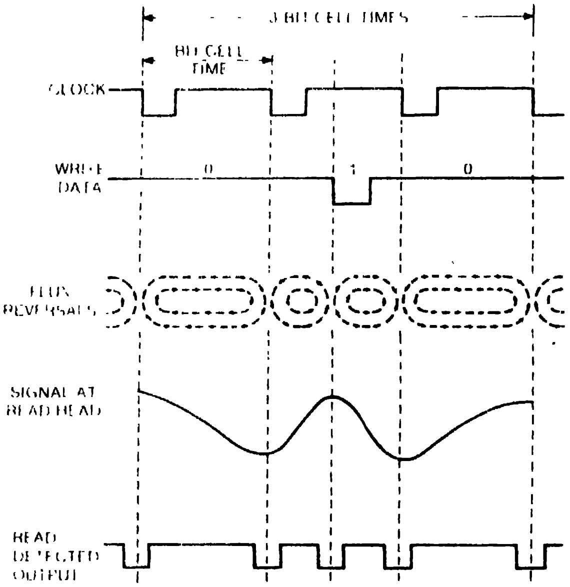


Fig. 7: Double-frequency recording.

Some definitions

Some technical terms which are often used in association with the moving head discs are explanied in the following paragraphs

Access time and seek time. The time taken to position a head on the selected track is called the seek time. The other time delay in locating selected data is the latency or rotational delay, which is the time required for the desired data to reach the magnetic head once the head is positioned.

The total time it takes to begin reading selected data or to begin writing one selected track in a particualr place is called the access time

Total access time = Seek time + Latency

Cylinder. As the discs are stacked exactly one above the other, a particular track will be lying in the same vertical plane for every surface of all the discs. All such tracks considered together are termed as the particular cylinder. Its capacity is given as

Capacity of particular cylinder = Capacity of a track × Total no. of surfaces used

Flying height. R/W heads used on magnetic discs are almost 'flying' type. A simplified diagram of a flying head is shown in Fig. 8. When the disc rotates at high speed a thin boundary layer of air rotates with the drive. The head is so shaped that it rides on this layer of rotating air which causes the disc to maintain separation from the head, thus preventing wear on the surface of the disc. In effect, the layer of air rotating with the disc acts like a spring with a stiffness of the order of several thousand pounds per cm, thus forcing the head away from the surface of the disc.

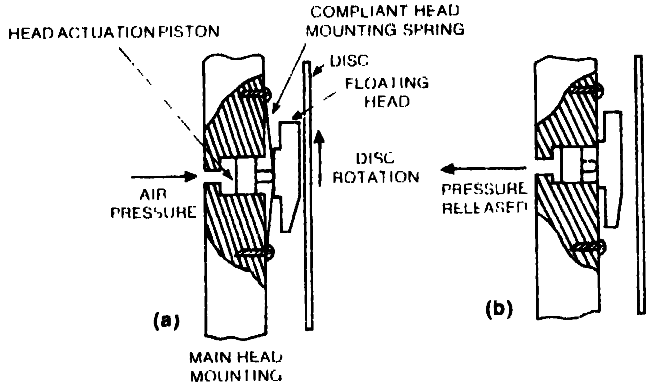


Fig. 8: Head shown in: (a) operating position, (b) retracted position.

Often, compressed air is simply blown in which forces the head towards the surface of the disc. The minimum distance between the surface of the disc and the head (when in operation) is known as the flying height of the disc.

Formatting. Information or data is stored in the disc in groups of 12, 18 or 22 sectors per track (depending upon the design of the disc). Each sector of all the tracks and all the surfaces of the disc-pack contain a 'header'. Header is an area in the sector where the cylinder number is written. In the write operation this header of the sought sector is first read and compared with the required cylinder number where the data is to be written. If they match, the data is written on that sector.

The disc, as it comes from the factory, is completely blank. On every sector of every track and on every surface of the disc, the respective header, i.e., the cylinder number is written with the help of a particular program. This process of writing the headers is called formatting of the disc. This is essentially done before putting the disc in operation.

Recording scheme. The data on the disc is recorded in a particular scheme. Every surface of the disc is divided into tracks or cylinders. Therefore, to record (write) or read the data, the drive number has to be defined first. Further, surface number, cylinder number and sector number have to be defined to access the exact area by the heads.

When the bulk of data is to be recorded, the head assembly of the selected drive moves to cylinder O position from its normal home position. The head of surface O is energised. The data is written on sector O till the last sector. If the data overflows, the head of the next surface, i.e., surface 1 is energised (and surface O de-energised) and the data written one by one on all the sectors of the same cylinder. If the data still overflows, it is written on the various sectors of next surfaces of the same cylinder till all the surfaces are over. If the overflow persists, the head assembly then moves to the next cylinder (i.e. cylinder 1) position and the same sequence continues. When all the cylinders of the disc are exhausted, the data overflows to the next disc (i.e. disc 1), and so on.

Comparative specifications

There are various sizes and speeds for disc memories. Some discs are quite large, ranging up to 1.2 metres in diameter. Others are smaller, rotate faster and are changeable. A typical changeable type or module type may have 20 recording disc surfaces consisting 10 discs. In most configurations top of the top disc and/or bottom of the bottom disc are not used for data recording. The table given compares the performance characteristics of a few discs:

DISC MAKE	DIGITAL RK05	CDC 215	UNIVAC 8440	IBM 3330-11
No of surfaces	2	20	20	19
Capacity in MB (mega bytes)	2.5	54	108	200
Track per inch	100	200	200	384
Data transfer rate (in mega bytes)	1.44	2.5	5.0	6.5
Av access time (in msec)	50	30	30	30
Rev/min.	1500	2400	2400	3600
Disc coating in μin	200	90	50	40
Flying height in μin	100	80	70	30

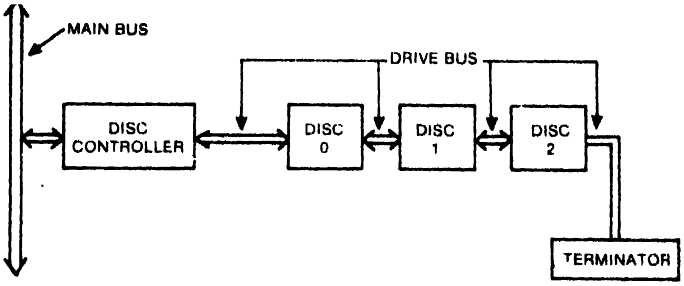


Fig. 9: Block diagram of a disc drive system.

The block diagram of the typical disc drive system is shown in Fig. 9. With one controller, four to eight discs can be connected in daisy-chain depending upon the memory capacity required.

In the daisy-chain system, the processor of the computer system puts the address of the required disc drive on the bus. The disc-controller fetches the address from the bus and passes it on to the first drive. The first drive decodes the address and if it happens to be its own address, it responds to the processor and performs the data-transfer. If the address does not pertain to the first drive, it passes it on to the next drive. This way the required drive gets selected in the daisy-chain operation.

Because of the relative inexpensiveness per bit of information or data stored in disc memories, and because of the relatively low access time and the high transfer rates attainable when reading or writing data from or into a disc file, magnetic disc memories have become one of the most important storage devices in modern digital computers. □

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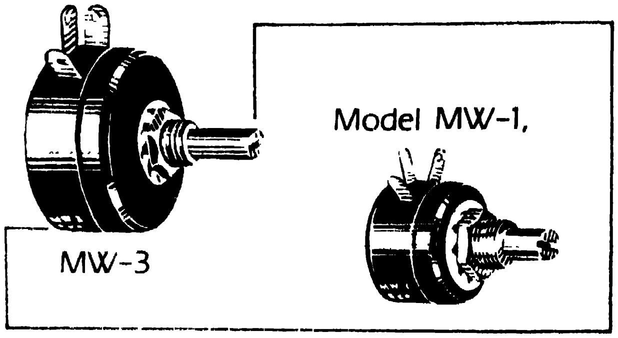

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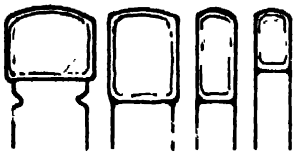

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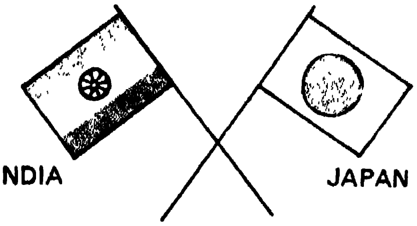

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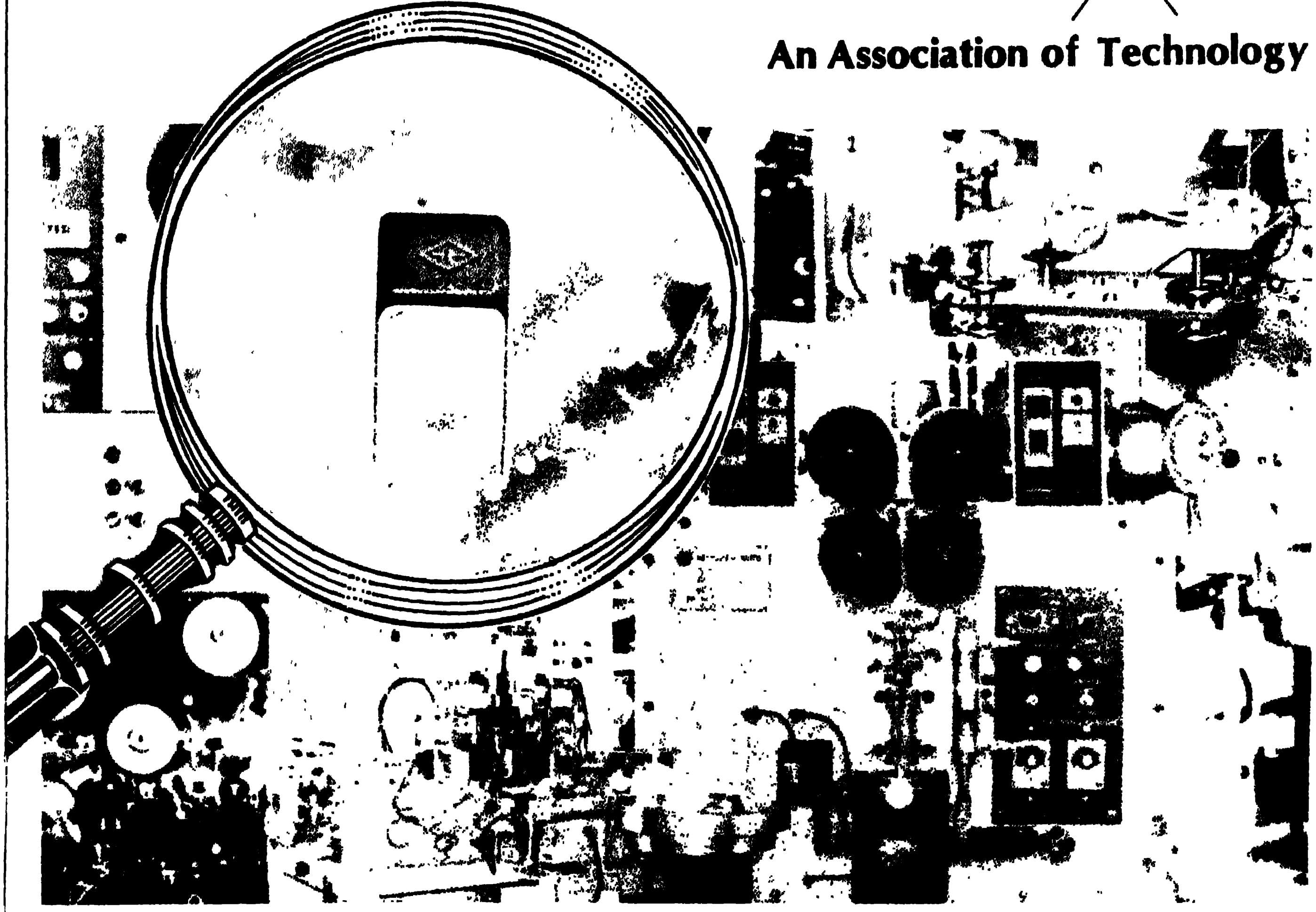

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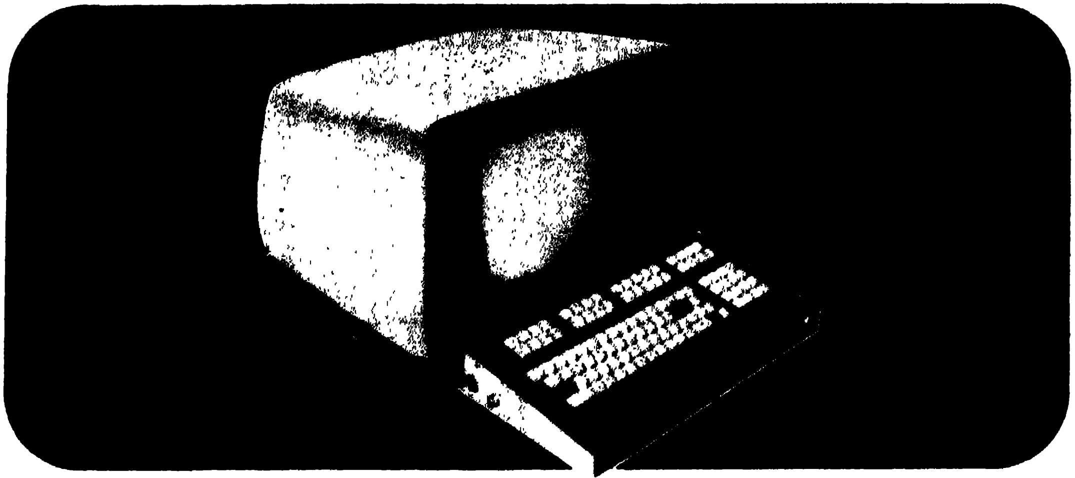

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Digital Resistance, Capacitance and Frequency Measurements

Using Sinclair Spectrum Micro

Ajay Chikersal

This construction project turns your Sinclair Spectrum Microcomputer into a Digital Resistance Capacitance Frequency Meter (DRCFM), capable of measuring resistances of 1 ohm to 10 megohm, capacitances in the 10pF to 5000µF range and frequencies as high as 100 kHz.

This project is different from all other interface projects you might have seen. It is cheap, interface is directly through the EAR socket (not the edge connector) and the circuit itself is so simple that it's sure to work the first time you connect it.

Working

The circuit is a free running astable multivibrator using the 555 timer chip. The output of the astable multivibrator is fed into the Spectrum through the EAR socket. The multivibrator produces square wave pulses, the frequency of which depends on the values of resistors and capacitors connected.

The machine language program (listing given in Fig. 1) is a simple counter which can count from 1 to 65535.

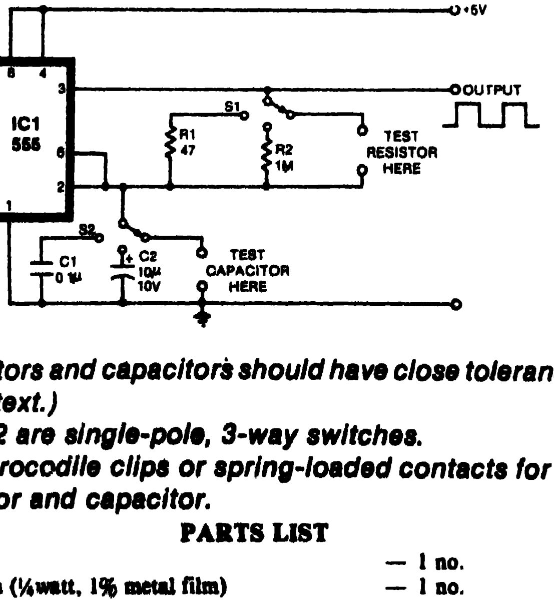
As the circuit is designed to give an equal mark/space ratio, the time periods of mark and space are equal, given by

$$T1=T2=0.7RC$$

Hence the total time period is given by

$$T=1.4RC$$

The circuit diagram of the main interface.



Resistors and capacitors should have close tolerances. (See text.)
S1, S2 are single-pole, 3-way switches.
Use crocodile clips or spring-loaded contacts for test resistor and capacitor.

PARTS LIST

IC555	— 1 no.
47-ohm (¼watt, 1% metal film)	— 1 no.
1-megohm (¼watt, 1% metal film)	— 1 no.
0.1µF ceramic	— 1 no.
10µF, 10V electrolytic	— 1 no.
1-pole, 3-way switch	— 2 nos.

IC sockets, crocodile clips, connecting cords. Sinclair Spectrum, colour TV/monitor, enclosure, and cassette recorder.

PROGRAM LISTING

```
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
        [illegible] DEFINED GRAPHICS"
[illegible]
[illegible]
[illegible] USR"m"[illegible]
[illegible]
[illegible]
[illegible] USR"m"[illegible]
[illegible]
[illegible],251,[illegible],219,254,60,32,250,
   [illegible],49
[illegible] BIN 01000010,BIN 01000010,
   [illegible] 01100110,0
[illegible] BIN 00010010,BIN 00010010,BIN 00010010,
   [illegible],BIN 00101001,0
[illegible] AT 1,15;PAPER 7;INK 3;"D.R.C.F.M"
[illegible] AT [illegible],1[illegible];"            "
[illegible] PRINT
[illegible] DIGITAL RESISTANCE CAPACITANCE FREQUENCY
   METER"
[illegible] PRINT PRINT
[illegible] PRINT"This program measures the value of
   resistance, capacitance or the Frequency of
   a square wave signal"
[illegible] FOR T 1 TO [illegible],NEXT T
[illegible]
[illegible]
[illegible] PRINT AT 1,1[illegible];PAPER 7;INK 3;"MENU",
[illegible] PRINT AT 2,1[illegible];"      "
[illegible] PRINT PRINT:PRINT
[illegible] PRINT"PRESS-R FOR RESISTANCE"
[illegible] PRINT AT 8,5;"-C FOR CAPACITANCE"
[illegible] PRINT AT 10,5;"-F FOR FREQUENCY"
[illegible] IF INKEY$ "r" THEN GOTO 300
[illegible] IF INKEY$ "c" THEN GOTO 500
[illegible] IF INKEY$ "f" THEN GOTO 700
[illegible] GOTO [illegible]
[illegible]

[illegible]10 PRINT AT 2,13;"RESISTANCE"
320 PRINT AT 3,13;"            "
330 PRINT:PRINT:PRINT
340 PRINT"PRESS [illegible] FOR RANGE 1 OHM TO 10K-OHM"
350 PRINT AT 10,6;"5 FOR RANGE 10K-OHM TO 10M-OHM"
360 IF INKEY$ "5" THEN LET O=1.7:GOTO 400
370 IF INKEY$ "1" THEN LET O=.00193:GOTO 400
380 GOTO 360
400 CLS
430 PRINT AT 10,11;"RESISTOR"
435 PRINT AT 11,11;"           "
440 LET K$="OHM"
450 GOTO 800
500 CLS
505 PRINT AT 2,13;"CAPACITANCE"
510 PRINT AT 3,13;"            "
520 PRINT PRINT.PRINT
530 PRINT"PRESS 5 FOR RANGE 10 pF TO 0.2uF"
540 PRINT AT 10,6;"1 FOR RANGE 0.2uF TO 5000uF
550 IF INKEY$ "5" THEN LET O=144117 : GOTO 6
560 IF INKEY$ "." THEN LET O=9.89:GOTO 600
570 GOTO 550
600 CLS
605 PRINT AT 10,11;"CAPACITOR"
607 PRINT AT 11,11;"           "
610 LET K$="uF"
620 GOTO 800
700 CLS
710 PRINT AT 10,11;"FREQUENCY"
720 PRINT AT 11,11;"           "
730 LET O 7.7·7E-6
740 LET K$="Hz"
750 LET R 1
800 PRINT AT 6,7;FLASH 1;"DEVICE UNDER TEST"
810 PRINT AT 14,7,"PRESS S TO STALL"
820 PRINT AT 16,13;"T TO TEST AGAIN"
825 LET U 0:LET P=0
830 LET J USR 50000
832 REM Machine code program starts at 50000
835 IF R 1 THEN LET J 1/J
840 LET U U+J:LET P=P+1
845 PRINT AT 12,10;"           "
850 PRINT AT 12,10;U/(O*P);K$
860 IF INKEY$ "t" THEN GOTO 180
870 IF INKEY$="s" THEN GOTO 870
875 FOR A=1 TO 10:NEXT A
880 GOTO 830
```

where 'R' is the resistance and 'C' the capacitance. A single count by the counter represents approximately 8.4×10^{-6} seconds. As the counter measures the total time period, the smallest measurable time period would be a single count or 8.4×10^{-6} seconds. So the highest measurable frequency is

$$f = \frac{1}{T} = 100 \text{ kHz}$$

If you notice the Z-80 assembler instructions (Fig. 1) carefully, you will come across the instruction IN A, (254). The action of this instruction is to load register A with the contents of input port 254 (representing the EAR socket). When no signal is applied to the EAR socket, register A contains the byte 255; when a signal is detected it contains 191.

Fig. 1: Machine code listing

Address	Hex	Z-80 Assembler
50000	01 00 00	LD BC,0
50003	DB FF	IN A, (254)
50005	3C	INC A
50006	28 FB	JR Z, -5
50008	03	INC BC
50009	DB FE	IN A, (254)
50011	3C	INC A
50012	20 FA	JR NZ, -6
50014	03	INC BC
50015	DB FE	IN A, (254)
50017	3C	INC A
50018	C0	RET NZ
50019	18 F9	JR, -7

To understand the action of this input port, type in the three line BASIC demonstration program (Fig. 2). Now load any cassette into the Spectrum (Rock, Pop, Jazz—even M.J. will do). The switching of numbers seen on the screen should give you the idea. By testing for the bytes 255 and 191, the machine language program is able to count the total time period of a single square wave pulse.

Fig. 2: Program to demonstrate input port-254.

```
10 REM DEMONSTRATION
20 PRINT AT 10,14; IN 254
30 GO TO 20
```

So by using a simple constant to relate computer count to seconds, we can measure the frequency of the incoming signal.

Due to its logical behaviour the computer can judge square waves best. Hence the use of a multivibrator instead of the conventional sine wave oscillator.

Once standardised with a known value of resistance and capacitance, it can then measure the value of either when the other is known.

Setting-up

The above paragraphs would have given you an insight of the actual working and the coordination between the external circuit and the Spectrum.

In order to get the project working, all you have to do is to connect the output of the astable multivibrator into the EAR socket of the Spectrum, type in the BASIC program, RUN it and move the switches S1 and S2 to their appropriate setting, insert the test device and observe the readings.

Fig. 3: Schematic showing the set-up to load the program.

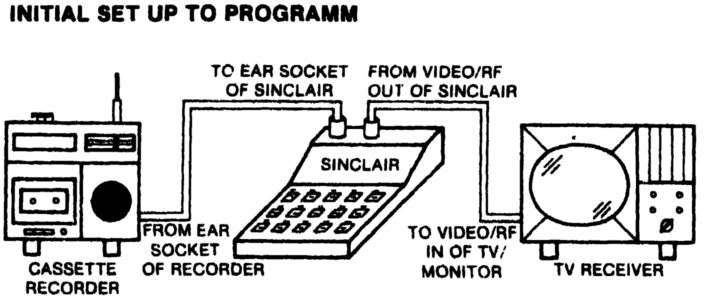
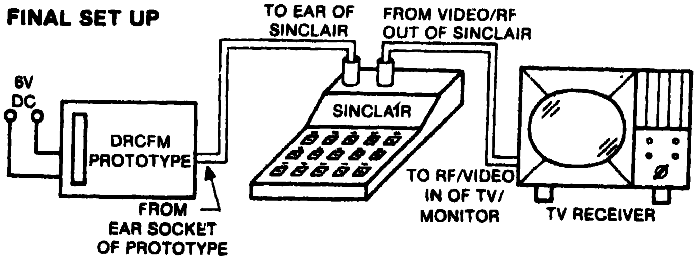

INITIAL SET UP TO PROGRAMM
TO EAR SOCKET OF SINCLAIR
FROM VIDEO/RF OUT OF SINCLAIR
SINCLAIR
FROM EAR SOCKET OF RECORDER
TO VIDEO/RF IN OF TV/ MONITOR
CASSETTE RECORDER
TV RECEIVER

Fig. 4: Schematic showing the set-up for 'measuring' the component values using the prototype.


FINAL SET UP
TO EAR OF SINCLAIR
FROM VIDEO/RF OUT OF SINCLAIR
6V DC
DRCFM PROTOTYPE
SINCLAIR
TO RF/VIDEO IN OF TV/ MONITOR
FROM EAR SOCKET OF PROTOTYPE
TV RECEIVER

For example, if you want to measure the value of a resistor which falls in the 1-ohm to 10-kilohm range, switch S1 should be moved to the 'TEST' position and switch S2 moved to the 10µF position. Please refer to Fig. 5, which will help you to decide the range and setting.

Fig. 5: Ranges with different switch settings.

Switch settings	Range
S1	To test capacitance
47-ohm	0.2µF to 5000µF
1-megohm	10pF to 0.2µF
S2	To test resistance
10µF	1-ohm to 10-kilohm
0.1µF	10-kilohm to 10-megohm

I have already standardised the value of constants used for computing the values of resistance, capacitance and frequency. However, by using the formula for time period with the values of resistance and capacitance used in the circuit, you can recalibrate to your satisfaction. To recalibrate, you must alter the value of variable '0' to suit the calculations of the time period. The variable '0' is contained in the following lines of the BASIC program: 360, 370, 550, 560 and 730.

I would strongly suggest you to use a 5V supply as the internal circuitry of the Spectrum uses 5V.

Be extremely careful while typing line 96 in the BASIC program. Since this line contains all the codes for the machine language program, one mistake and your Spectrum will most likely go into a 'crash' as soon as you run it. ('Crash' is machine language jargon for program overrun.) This stubborn mode of the Spectrum might dazzle you with colour and graphics but will definitely shock you when you learn that the only way of getting the Spectrum back to its normal mode is to turn it off and on, thereby losing the entire program.

I would also suggest you to use resistors and capacitors of very close tolerances as this will not only ensure proper matching between my standardisation of formulae and your components, but will also help you to recalibrate in order to obtain good readings.

Try the BASIC demonstration program again. This time press different keys and observe what happens on the screen. You will notice that the contents of input port 254 get affected by pressing the keys. So here's another precaution. Don't press any key on the keyboard while measuring the value of the test device.

The symbols Ω (ohm) and µ (micro) in the BASIC program listing can be obtained by using Graphic 'o' for ohm and Graphic 'm' for micro.

The BASIC program was written for a 48k Spectrum. However for the benefit of 16k Spectrum owners I have listed the amendments in Fig. 6.

Fig. 6: Amendments for 16k Spectrum.

```
  5 CLEAR 32499
 10 FOR L=32500 TO 32520
830 LET J=USR 32500
```

Recalibration

Let me illustrate the process of recalibration by considering a practical example.

Set switch S1 to 1-megohm and switch S2 to 0.1µF.

Now the time period of the square wave generated is given by the formula

$$T=1.4RC$$

Substituting the value of resistance and capacitance in the above formula, we obtain

$$T=1.4\times10^{-2}\text{ seconds}$$

Now insert another line in the BASIC program

```
827 LET 0=1
```

so that you obtain the exact averaged computer count. If you wish to calibrate with reference to your 1-megohm resistor, you will find that the range corresponds to switch position S2 to 0.1μF.

By simple arithmetic manipulation to the formula of line 850, you can find the value of '0' so that you get 1-megohm as the answer.

As this value of '0' corresponds to the range 10-kilohm to 10-megohm, it should replace the existing value of '0' in the line 370. Don't forget to remove the additional line 827 after you have finished recalibrating.

Further applications

The circuit is so simple and versatile that with only two parameters of control it can be easily modified to suit endless purposes.

Here are a few ideas to experiment with:

1. Replace the resistor by an LDR (light dependent resistor) .... Light meter!
2. Replace the capacitor by a grid of parallel plates (similar to a parallel plate capacitor) .... Rain alarm, Moisture meter!
3. Replace the resistor by an LDR which is encapsulated with an LED, the latter being supplied with voltage from an independent supply .... Digital voltmeter!
4. Using a sensitor (a silicon resistor) in place of the resistor .... Thermometer!

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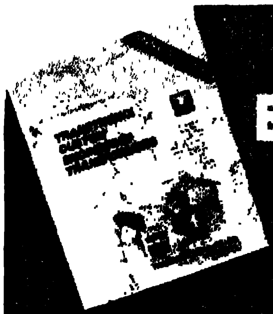

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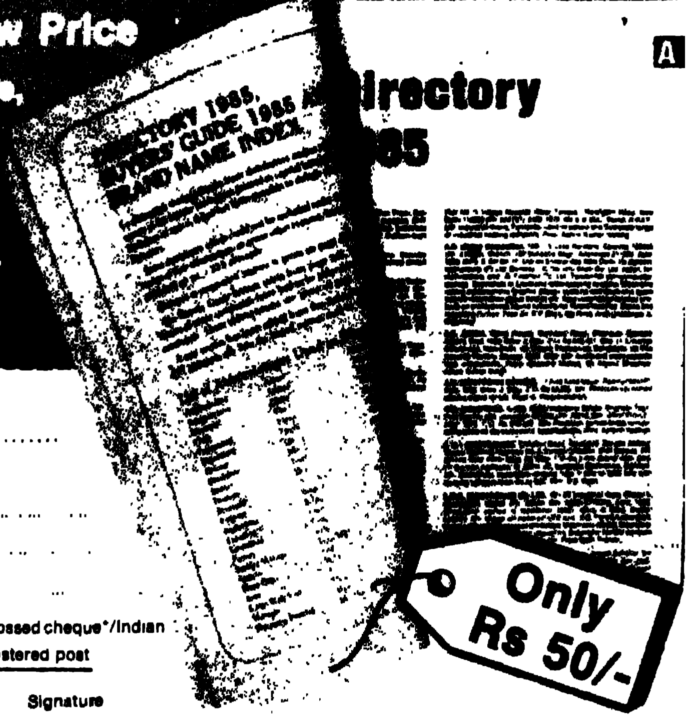

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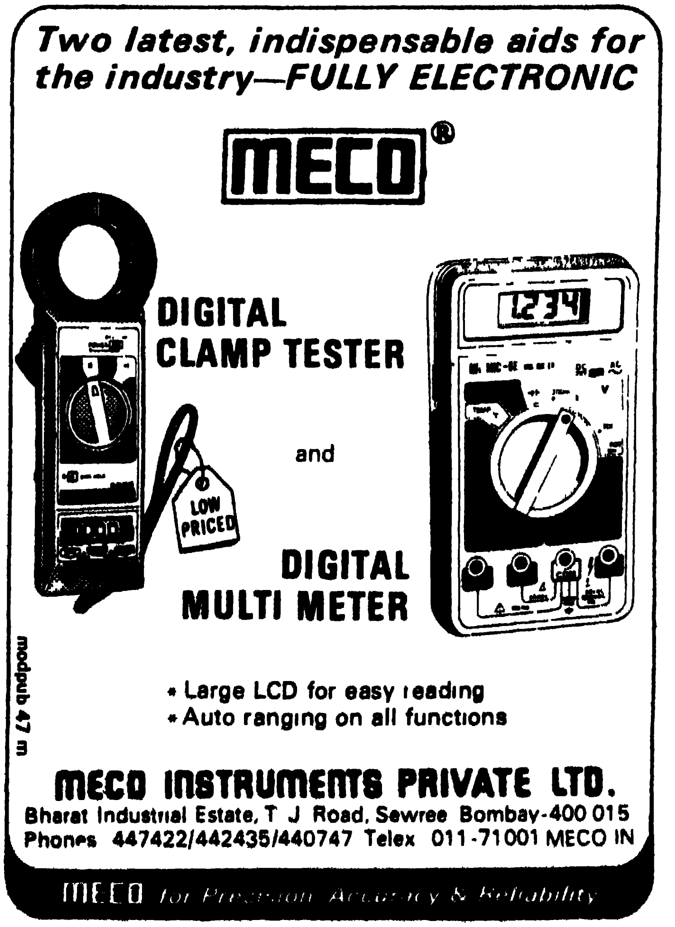

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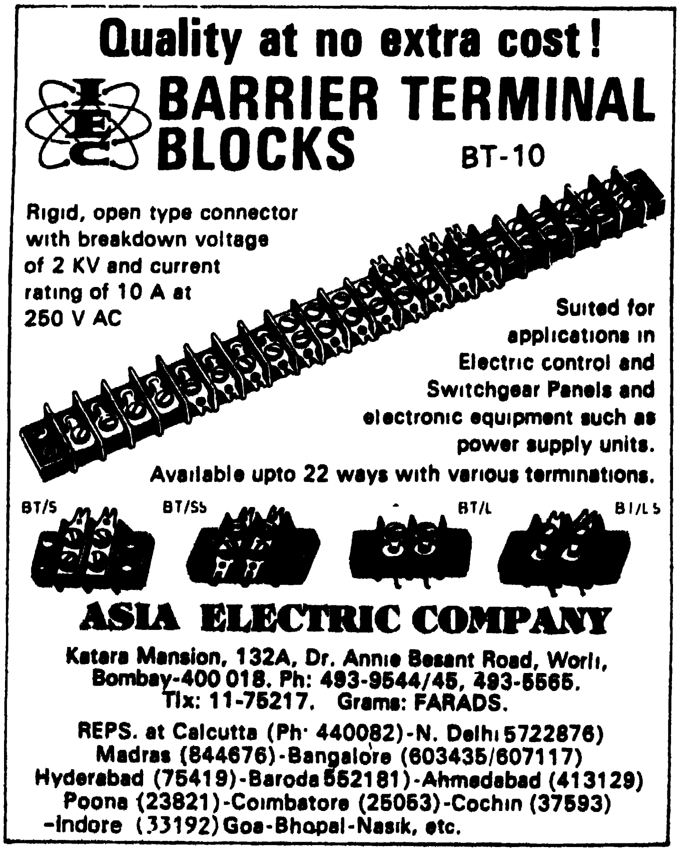

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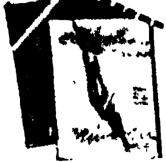

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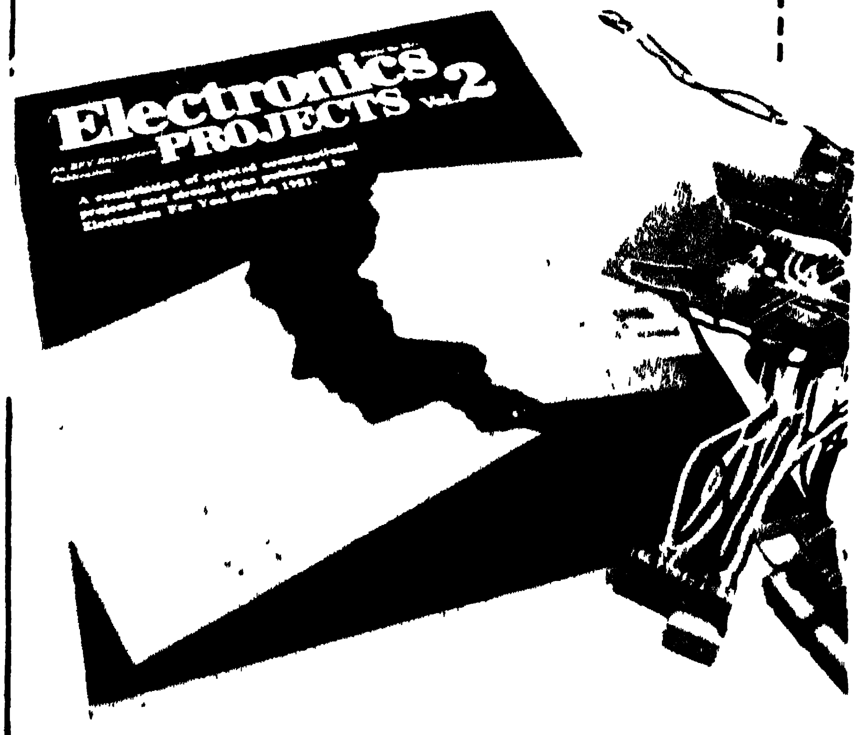

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Comparative Study of Computer Languages

Library Functions

Part VIII

R. Ramaswamy

In scientific computations, several functions like sine, cosine etc will be repeatedly used. The values of such functions have to be obtained by executing a program for such evaluation. If a sine function occurs ten mes in a program, the segment of the program for evaluat- g the sine function must be written ten times. If we use broutines (we will discuss later about subroutines) the rogram segment must be written at least once. Even this is voided in the case of library functions. The program seg- ents for evaluation of such oft-repeated functions form rt of the language itself.

The FORTRAN compiler provides for the computation f such oft-repeated functions by storing the program for ch computations A code name is given for invoking the nction in the main program. Immediately following the de name, a variable or a constant or an expression is closed within parantheses, called the argument of the nction. The program will use the computed value of the gument to evaluate the value of the function itself and turn it to the main program. The general form of the rary function is:

function-name (argument)

e function name is coined in such a way that it is indicative the nature of the function and it is given by the compiler signer. Suppose one writes SQRT (24.5), the term SQRT called the name of the function and the number 24.5, the gument of the function. The purpose of this function is to mpute the square root of the number within the paran- ses and return the value to the main program. In this case, argument is a mere number. In general, it can be a able or an expression. The computer will first compute expression inside the argument and use this value for evaluating the square root function.

If the argument has not been defined earlier, the computer will give an error message. The algebraic form and the FORTRAN form of the functions built inside the FORTRAN compiler are shown in Table 8.1. The programs for evaluating these functions are inside the compiler itself. So these functions can be called system defined. Later it will be shown that the user also can define functions for his use in particular programs.

FORTRAN library functions

TABLE 8.1

Algebraic Form	FORTRAN Form
$x^{1/2}$	SQRT(X)
$\|x\|$	ABS(X)
$\|k\|$	IABS(K)
e^{x}	EXP(X)
sin x	SIN(X)
cos x	COS(X)
$\log_e x$	ALOG(X)
$\log_{10} x$	ALOG10(X)
$\tan^{-1} x$	ATAN(X)

The computed values of all these functions except the IABS function will be in the real mode. The arguments of all the functions except the IABS function must be in the real mode. Only the IABS function returns an integer value. In the case of sine and cosine functions, the values of the arguments must be given in the radian measure. If the angle θ is in degrees, it must be converted to radian measure and the argument written as THETA*22.0/(7.0*180.0).

The arguments of the library functions may be either constants or variables or expressions. Of course, the variables occurring in the argument must be defined beforehand, otherwise the computer will give an error message. Defining a variable means assigning a value to it. There may be some more library functions available with a particular machine and they can be ascertained from the manual of that machine.

Converting algebraic expressions to FORTRAN expressions

We have completed all the rules relating to the coding of constants, variables, operators and expressions in FORTRAN. So, theoretically, we must be in a position to convert any algebraic expression into FORTRAN expression. We know that the expression occurs on the right side of a formula and it is only the computed values of such expressions that give us the solutions to problems. Please brush up your mathematics knowledge and the coding rules in FORTRAN and be in a position to convert any algebraic expression into FORTRAN expression. Some examples to illustrate such conversions from algebraic form to FORTRAN form are given below:

Algebraic Form	FORTRAN Form
$ax + b$	A*X + B
$ijklm$	I*J*K*L*M
$\sec(x)$	1.0/COS(X)
$\tan(x)$	SIN(X)/COS(X)
$\sinh(x)$	(EXP(X) – EXP(–X))/2.0
$\lvert a \rvert e^x$	ABS(A)*EXP(X)
a^{bc}	A**(B*C)
$(b^2 - 4ac)^{½}$	SQRT (B*B – 4.0*A*C)
$\sec(\tan^{-1}x)$	1.0/COS(ATAN(X))
2.5^3	2.5**3
2^3	2.0**3
$\pi r^2h/3$	22.0*R*R*H/(7.0*3.0)
$25a/71$	25.0*A/71.0
$\sin^2\theta$	SIN(THETA)**2
$\sin\theta^2$	SIN(THETA**2)
$(a+b)^{1/3}$	(A+B)**(1.0/3.0)

In the last example one must not write the FORTRAN expression as (A+B)**(1/3). Since 1/3 is in the integer mode, it will be evaluated as zero. So the computer will evaluate $(a+b)^0$ which is not what we intend to calculate. The fraction 1/3 must be evaluated in the real mode. So we have to give the fraction as (1.0/3.0).

Library functions in BASIC

There are a large number of library functions in BASIC which lead to both numeric and string values. The introductory para on library functions at the beginning of the article is valid for BASIC. The list of library functions and their meanings are given below:

Function Name	Meaning
ABS(X)	Absolute value of x
SQR(X)	Square root of x
SIN(X)	Sine (x), where x is in radian mea sure
COS(X)	Cosine (x), where x is in radia measure
ATAN(X)	Arc tan of x or tan inverse of x. Th function returns the angle in radia measure whose tangent is x.
LOG(X)	Logarithm of x to the Naperia base 'e'
EXP(X)	e^x
INT(X)	Integer part of x
RND(X)	This function will return on random number between 0 an 1.
SGN(X)	Sign of x. This function will retur -1 if the argument is less than 0, 0 the argument is 0 and +1 if the argu ment is greater than 0.
STR$(X)	This is called string dollar functio This converts the numeric value of to string. If x is 2345, then STR$(X becomes "2345".
VAL(X$)	This is called Val function. Th function converts the numeri string stored by X$ into the corres ponding numeric value. If X$ "2345", then VAL (X$) is 2345. If X is not a numeric string, the VA function will return zero value.
LEN(X$)	This is called the Len function. Th function returns the length of th X$ string in terms of the number c characters in the string. If X$ is "R KRISHNAN", then LEN(X$) wi return 11.
ASC(X$)	This is called Aske function. Th function will return the ASC value of the first character of the X string. If X$ is "A", then ASC(X will return 65. Similarly, every cha acter will be stored in the form of number called the ASCII value that character.
CHR$(X)	This is called Chr dollar functio This function returns the charact whose ASCII equivalent value the integer part of the numeric arg ment. For example, CHR$(65) wi return the character "A". This fun tion does the reverse of the AS function.
LEFT$(X$,n)	This is called the left dollar fun

	tion. This function returns one or more characters from the left end of the X$ string. If n is 1, then one character will be returned. If n is 2, then two characters will be returned and so on. If X$ is "2345", then LEFT$(X$,1) will return "2", LEFT$(X$,2) will return"23"and so on.
IGHT$(X$,n)	This is called the right dollar function. This function returns n characters from the right end of the X$ string. If X$ is "2345", then RIGHT$(X$,1) will return "5", RIGHT$(X$, 2) will return"45"and so on.
ID$(X$,m,n)	This is called the mid dollar function. This function returns n characters starting from the mth position of the X$ string. If X$ is "2345", then MID$(X$, 2, 1) will return "3", MID$ (X$, 3, 1) will return "4", MID$(X$, 2, 2) will return"34"and so on.
ATCH(Y$,X$,n)	This is called the match function. This function returns a numeric value. It will search for the occurrence of the Y$ string in the X$ string starting from the nth position of the string and return the position of the occurrence of the string Y$. If Y$ string does not occur in the X$ string starting from the nth position, it will return 0. If X$ is "MISSES", Y$ is"SS"and n is 1, then MATCH(Y$,X$,1) will return 3, MATCH (Y$,X$, 4) will return 0, MATCH (X$, Y$,2) will return 2 and so on.

There may be some more library functions available with particular machine and they can be ascertained from the anual of that machine. BASIC does not make distinction etween reals and integers as FORTRAN does. All compu-tions are done in the real mode. If one wants integer rithmetic to be done, the item must be converted to integer ode using the INT function. The following examples illus-ate the conversion of some algebraic expressions to the ASIC form:

gebraic Form	BASIC Form
x+b	A*X+B
klm	I*J*K*L*M
c(x)	1/COS(X)
n(x)	SIN(X)/COS(X)
nh(x)	(EXP(X)-EXP(-X))/2
e^x	ABS(A)*EXP(X)
	A∧(B*C)
$(b^2-4ac)^{1/2}$	SQR(B*B-4*A*C)
$\sec(\tan^{-1}x)$	1/COS(ATAN(X))
2.5^3	2.5∧3
2^3	2∧3
$\pi r^2h/3$	22*R*R*H/(7*3)
25a/71	25*A/71
$\sin^2\theta$	SIN(THETA)∧2
$\sin\theta^2$	SIN (THETA∧2)
$(a+b)^{1/3}$	(A+B)∧(1/3)

In a similar manner one can convert any algebraic expression to the BASIC form.

Library functions in PL/1

There are a number of library functions or built-in functions in PL/1 also which can be used without any prior declaration in a program. The list of library functions and their meanings are given below:

Library Functions	**Meaning**
SIN(X)	Returns the sine of x, where x is in radian measure. Result is in float binary (real in scientific notation)
COS(X)	Returns the cosine of x, where x is in radian measure. Result is in float binary (real in scientific notation)
LOG(X)	Returns the natural logarithm of x in float binary
ATAN(X)	Returns arc tan(x) or $\tan^{-1}x$ in float binary radian measure.
EXP(X)	Returns the value of e to the power x in float binary
ABS(X)	Returns the absolute value of x
CEIL(X)	Returns the smallest integer greater than or equal to x. If x is 1.2, CEIL(X) is 2 and if x is−1.2, CEIL(X) is −1
FLOOR(X)	Returns the greatest integer less than or equal to x. If x is 1.2, FLOOR(X) is 1 and if x is−1.2, FLOOR(X) is−2
MAX(X, Y)	Returns x if x is greater than or equal to Y, otherwise returns Y
MIN(X, Y)	Returns x if x is less than or equal to X, otherwise returns Y
MOD (X, Y)	Returns the value of x mod y. If x and y are integers, then x mod y gives the reminder when x is divided by y. If y is equal to 0, then x is returned. Otherwise it returns X-ABS(Y)*FLOOR(X/ABS(Y)), e.g., MOD(7, 3) is 1 MOD(−7, 3) is 2 MOD(7,−3) is 1 MOD (−7,−3) is 2
ROUND(X, K)	Returns x rounded to K digits to the right of the decimal point. If K is less than 0, then x is rounded of to K digits

	to the left of the decimal point, e.g., ROUND(12345.24689,3) returns 12345.24700 ROUND(12345.24689,-3) returns 12000.00000
TRUNC(X)	Returns the integer portion of x. If x is less than 0 returns CEIL(X) and if x is greater than or equal to zero, then returns FLOOR(X), e.g., TRUNC(52.146) is 52 TRUNC(-52.146) is -52
SIGN(X)	Returns −1 if x is less than 0, returns 0 if x is equal to 0, returns +1 if x is greater than 0
SQRT(X)	Returns the square root of x in float binary

There may be some more library functions depending on the machine and the same can be referred to from the manual of the particular machine. In forming expressions, integers and reals can be mixed as in the case of BASIC, but precision errors are likely to occur because every variable is declared in the beginning. Suppose A and B are declared as integers whose values are 2 and 3 respectively, and C is declared as real, and if one writes C=B/A, one will get an answer 1.0.

In PL/I all calculations are done in float binary (i.e. real in the scientific notation). The final result can be given either in floating notation or exponent notation. Some of the rules relating to actual computation vary from machine to machine and so it is advisable to refer to the manual of that machine while trying to do arithmetical simplifications.

Library functions in PASCAL

The following standard functions or library functions are available in PASCAL:

Function Coded as	Argument Type	Result Type and Meaning
ABS(I)	Integer	Absolute value of integer given in the integer mode, e.g., ABS(-4) is 4
ABS(R)	Real	Absolute value of real given in the real mode, e.g., ABS(-3.4) is 3.4
SQR(I)	Integer	Square of integer given in the integer mode, e.g., SQR(2) is 4
SQR(R)	Real	Square of real given in the real mode, e.g., SQR(4.0) is 16.0
TRUNC(R)	Real	Integer part of real when R is real. It is used to convert real to integer, e.g., TRUNC(4.5) is 4
ROUND(R)	Real	It rounds the number to the nearest integer, e.g., ROUND(1.2) is 1 and ROUND(1.8) is 2
SIN(R)	Real or integer	Sine of the angle given in radian measure. Result is real irrespective of the mode of the argument
COS(R)	Real or integer	Cosine of the angle given in radian measure. Result is real irrespective of the mode of the argument
ARCTAN(R)	Real or integer	The inverse of the tangent of the argument in radians in the real mode irrespective of the mode of the argument
LN(R)	Real or integer	Natural logarithm of the argument in the real mode irrespective of the mode of the argument
EXP(R)	Real or integer	Exponential of the argument, e^x, in the real mode irrespective of the mode of the argument
SQRT(R)	Real or integer	Square root of the argument in the real mode irrespective of the mode of the argument

Coding of algebraic expressions in PASCAL

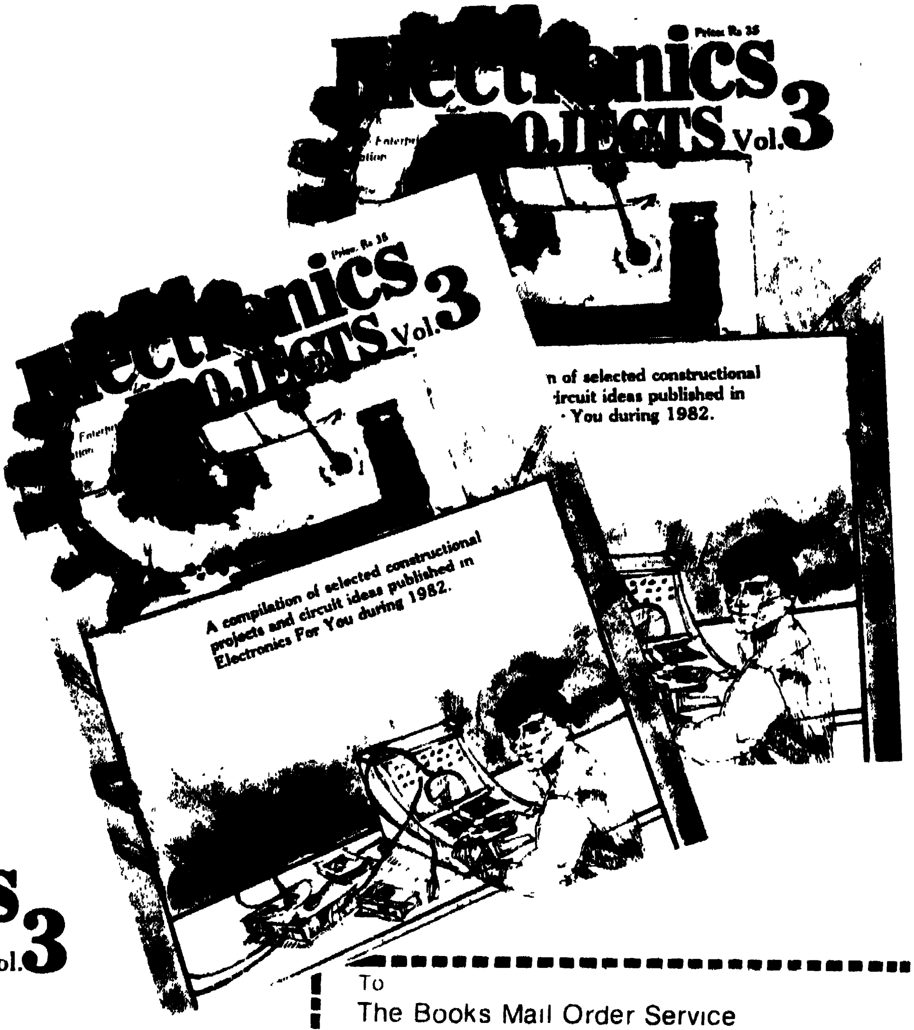
The following examples illustrate the coding of algebraic expressions in PASCAL form:

Algebraic Form	PASCAL Form
$ax+b$	A*X+B
$ijklm$	I*J*K*L*M
$\sec(x)$	1/COS(X)
$\tan(x)$	SIN(X)/COS(X)
25/71	25 DIV 71 or 25/71 depending on whether integer arithmetic or real arithmetic is required to be done
x^2	SQR(X) or X*X
a^b	EXP(B*LN(A))
$(b^2-4ac)^{1/2}$	SQRT(B*B − 4*A*C)
$\sin^2\theta$	SQR(SIN (THETA))
$\sin\theta^2$	SIN(SQR(THETA))
$\sinh(x)$	(EXP(X) − EXP(−X))/2
$\sin^{-1}x$	ARCTAN(X/SQRT(1−X*X))
$\cos^{-1}x$	ARCTAN (SQRT(1−X*X)/X)
a^{bc}	EXP(B*C*LN(A))
$pnr/100$	P*N*R/100
$p(1+r/100)^n$	P*EXP(N*LN(1+R/100))

The main function of a computer is to compute the value of an expression which is coded in a high-level language. We know that the right hand side of a formula always contains an expression. So, by computing an expression, the computer will be able to get at the solution of a problem. Thus it is clear that a major task in learning a computer language is achieved when one is able to convert any algebraic expression into the corresponding computer language expression.

What remains is to convert this into complete instructions. Complete instructions are given in the form of statements. From the next lesson onwards we will start studying the different types of statements used to give different instructions to the computer.

(To be continued next month)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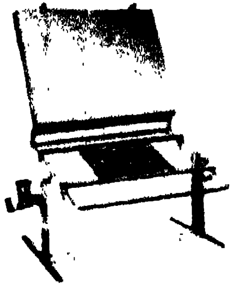
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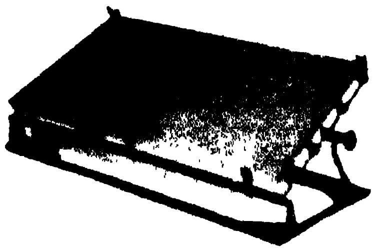
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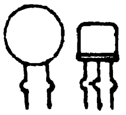

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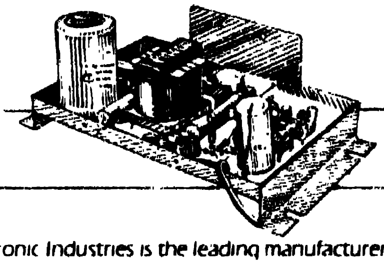

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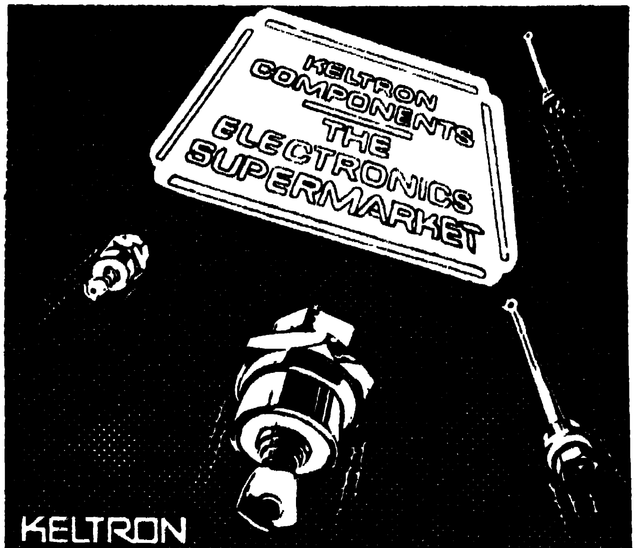

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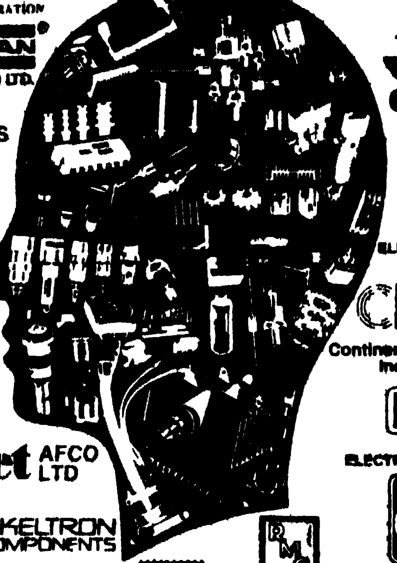

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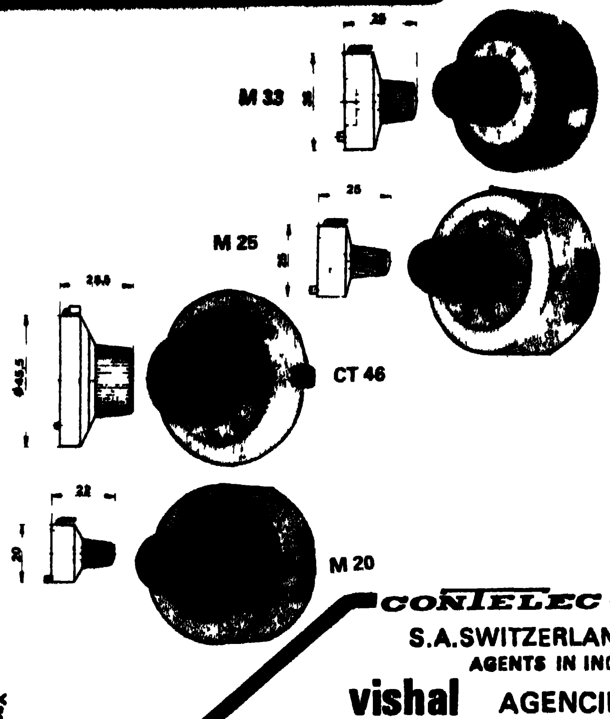

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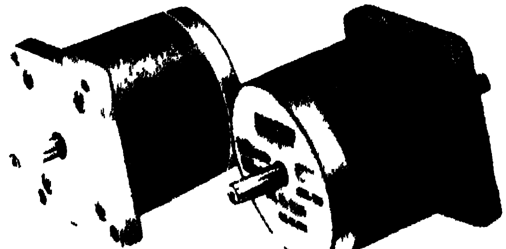

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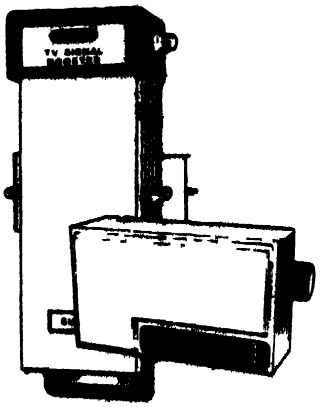

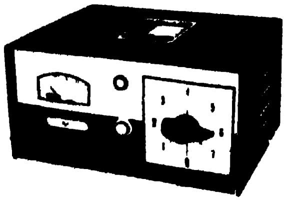

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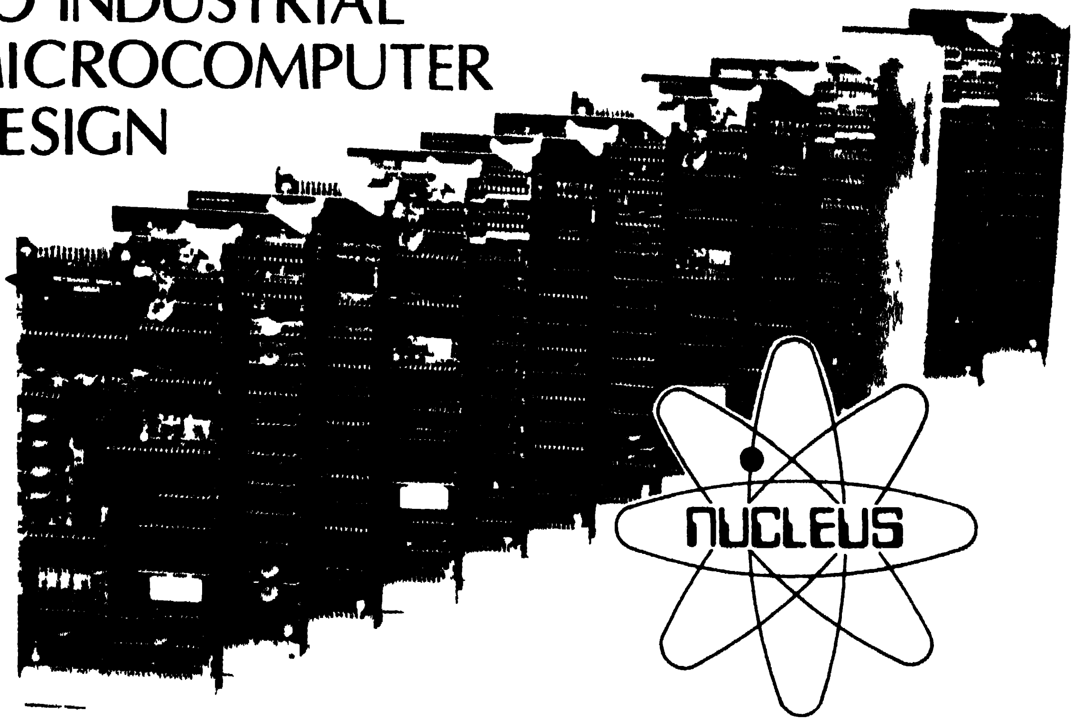

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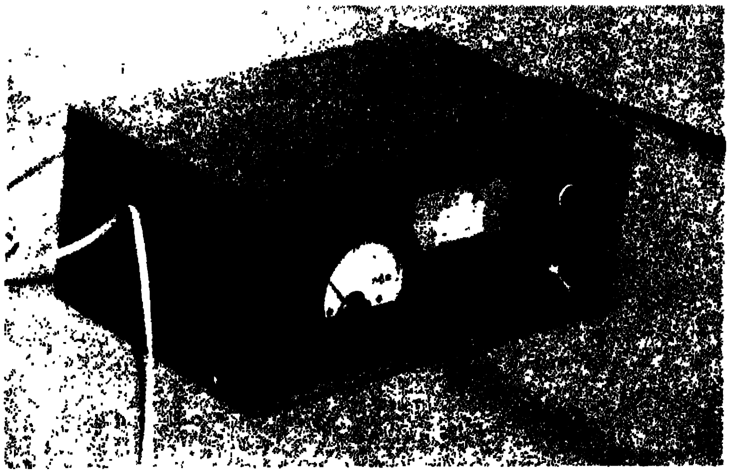
DESIGN CENTRE

Solidstate Automatic AC Voltage Regulator



Balakrishna P.

Maintaining constant voltage is very difficult. This problem can be solved by using automatic voltage stabilisers. Although a number of automatic voltage regulators are available in the Indian market and are advertised as solidstate automatic voltage regulators, most of them cannot be said to be true solidstate devices.

Invariably, the voltage level sensing circuits in these automatic voltage regulators are of solidstate design but the controlling elements are usually relays or motor driven variacs which are actually mechanical devices. This article will describe how to design and fabricate a 'true' solidstate automatic voltage regulator, without a single moving element in its circuitry.

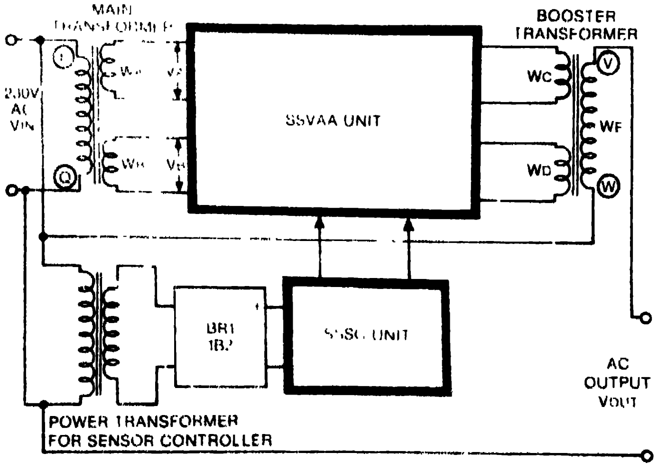


Fig. 1: Block diagram of the automatic voltage regulator.

Boosting principle

As shown in Fig. 1, the incoming line voltage, V_{IN}, is stepped down to voltages V_A and V_B at the secondary windings W_A and W_B respectively of the input transformer. The booster transformer has two primary windings, W_C and W_D, connected to the SSVAA (solidstate variable amplitude amplifier), which drives it in accordance with the control signals obtained from the SSSC (solidstate sensor and controller). One of the terminals of the secondary windings of the booster transformer is connected to the input and the other forms one of the output terminals. Another output terminal is taken from the input, to which the secondary of the booster transformer is not connected.

The input voltage is stepped down, rectified and the DC voltage is fed to the SSSC which detects the variations in the input voltage and provides the required correction control signal to the SSVAA.

Working of the SSVAA unit

This unit,as shown in Fig. 2,consists of two power transistors T1 and T2; four diodes D1, D2. D3 and D4; and three resistors VR1,R4 and R6. R4 is a light-dependent resistor

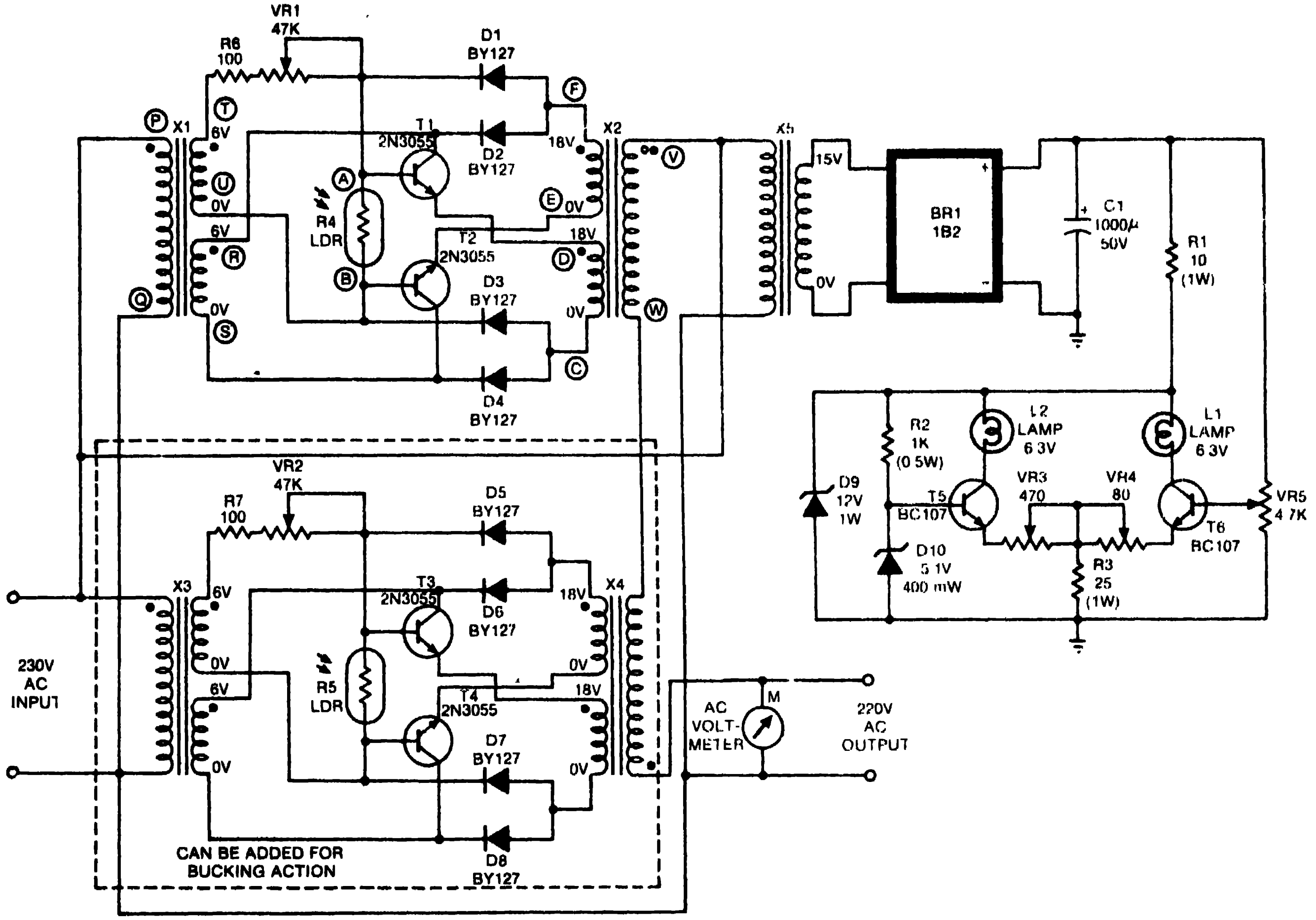


Fig. 2: Circuit diagram for solidstate automatic voltage regulator.

PARTS LIST

Semiconductors:	
T1-T4	— 2N3055 npn power transistor
T5, T6	— BC107 npn transistor
D1-D8	— BY127 rectifier diode
D9	- 12V, 1-watt zener diode
D10	-- 5.1V, 400mW zener diode
BR1	— 1B2, 1-amp bridge rectifier diode
Resistors (all ¼watt ±5% carbon, unless stated otherwise):	
R1	— 10-ohm, 1-watt
R2	- 1-kilohm, 0.5-watt
R3	— 25-ohm, 1-watt
R4, R5	— 100-ohm
R6, R7	– LDR (light dependent resistor)
VR1, VR2	– 47-kilohm potentiometer
VR3	– 470-ohm potentiometer
VR4	80-ohm potentiometer
VR5	— 4.7-kilohm potentiometer
Capacitor:	
C1	— 1000µF, 50V electrolytic
Miscellaneous:	
X1, X3	- 230V primary to two 0-6V, 1-amp secondary transformer
X2, X4	— Two 0-18V primary to 230V, 2-amp secondary transformer
X5	— 230V primary to 15V,1-amp secondary transformer
L1, L2	— 6.3V, 0.3-amp lamp
	— PCB, heatsink for power transistor, AC voltmeter, 7/36 flexible wire, suitable enclosure, screws, nuts, washers etc.

(LDR). The resistance value of the LDR is inversely proportional to the incident light on its active surface.

The circuit is a special form of 'class B' emitter follower amplifier with the collector supply fed from an AC source instead of conventional DC supply. Since the various windings have to be connected in a particular phase relationship, at any instant when point P is positive with respect to point Q at the input of the mains transformer X1, points R, T and V will be positive with respect to points S, U and W in windings W_B, W_A and W_E as shown in the block diagram.

Considering such an instant, winding W_A drives a current through R6 and VR1. This current produces voltage V_C across the terminals A-B of the LDR. From the above assumption of polarity, point 'A' of this voltage will be positive with respect to 'B' and cause a base current to flow through the transistor T1, along the path A-D-C-B-A and on account of this base current drawn from winding W_B, along the path R-T1-D-C-S-R.

The above explanation covers half a cycle when point P is positive with respect to Q. At the end of this half cycle, during the period of zero crossing, the voltages V_C, V_A and V_B are all equal to zero after which the negative half cycle commences. During the negative half cycle, point 'B' becomes positive with respect to point 'A' and thus diode D3

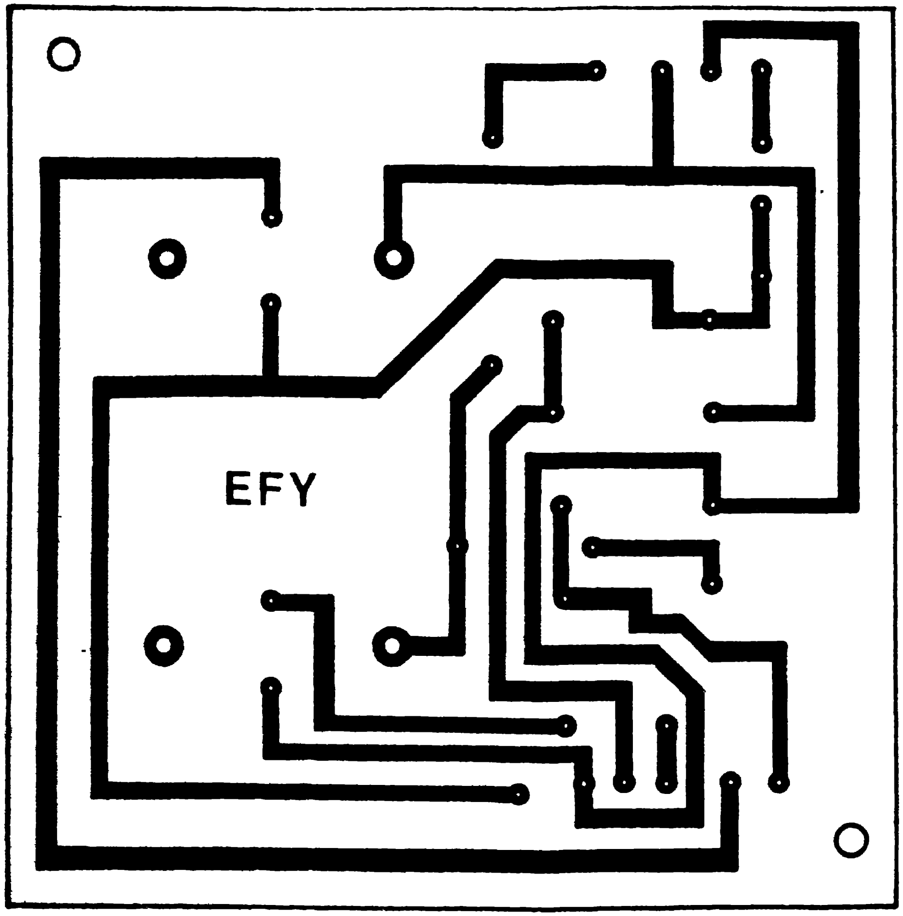


Fig. 3: Actual size PCB layout for variable amplitude amplifier.

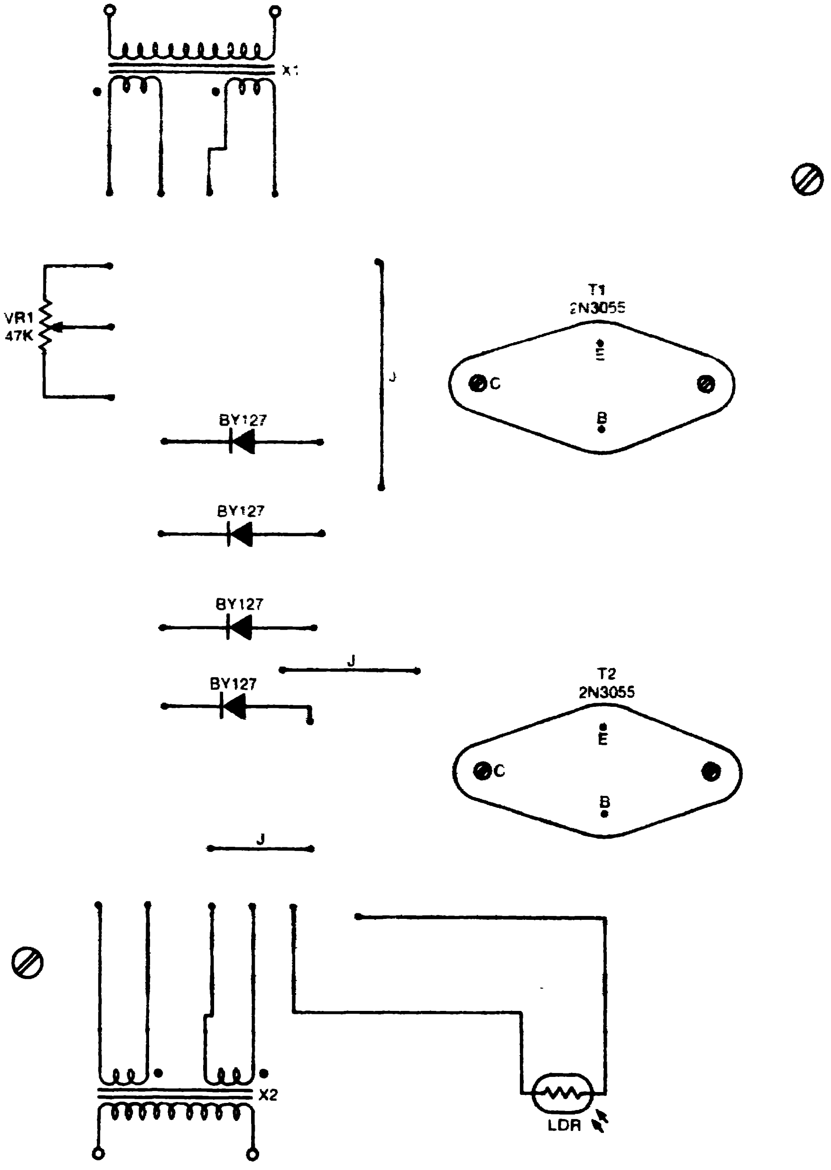


Fig. 4: Component layout for the PCB.

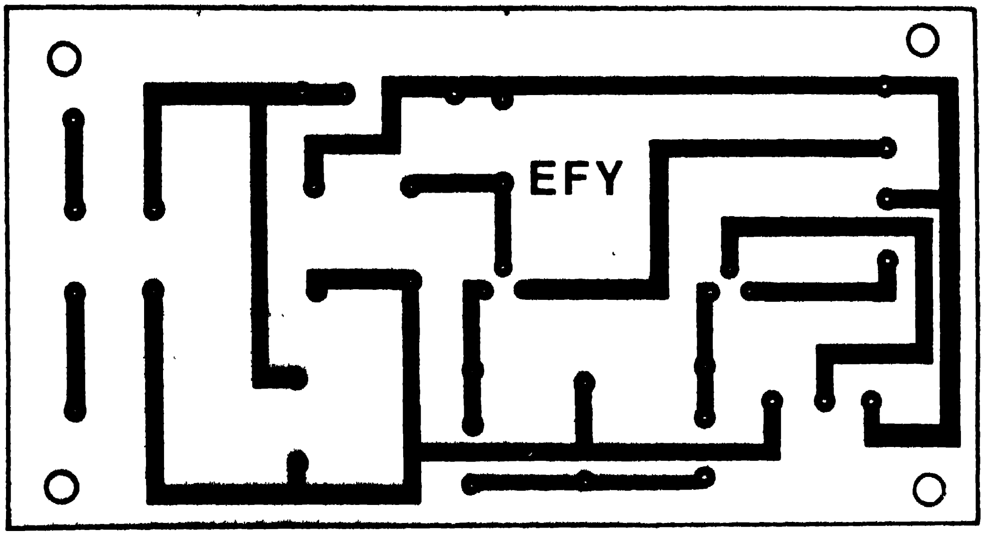


Fig. 5: Actual size PCB layout for the sensor and controller.

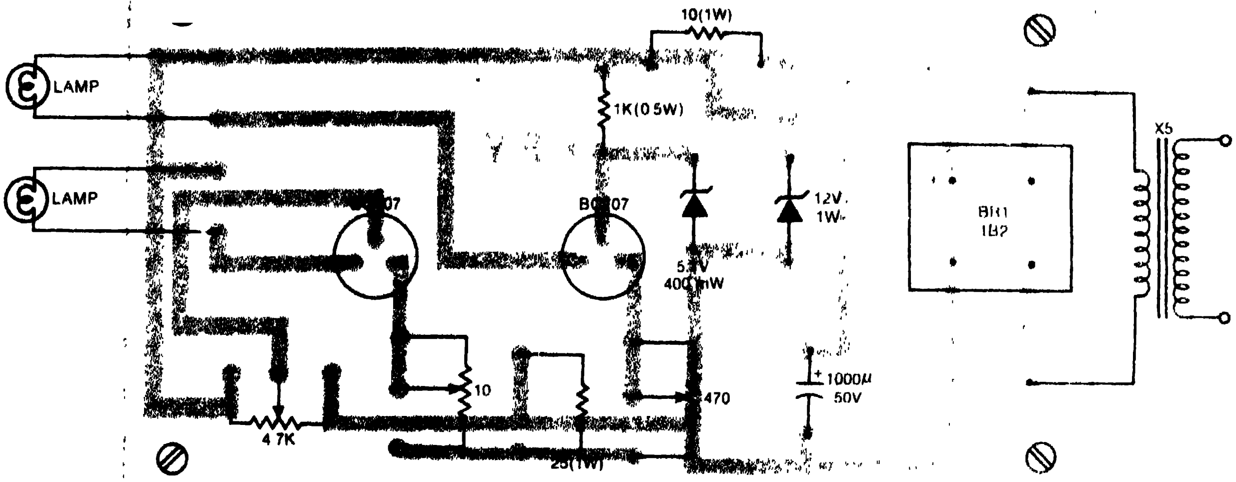


Fig. 6: Component layout for the PCB.

blocks any current through W_D. But a base current flows through transistor T2 and winding W_C causing a collector current along the path S-T2-E-F-R-S.

Solidstate sensor and controller

The input for the SSSC is obtained directly from the supply voltage through a stepdown transformer X5 and a bridge circuit used for sensing and controlling the variations in the supply is a differential amplifier.

Transistors T5 and T6 are connected (as shown in Fig. 2) so as to obtain a differential amplifier configuration at normal AC voltage of 230 volts. The potentiometer VR5 (4.7k) is adjusted to obtain maximum brightness of the lamp. When the input AC voltage decreases, the voltage applied to the base of T6 decreases. This causes a decrease in the collector current of T6 and thus a decrease in the brightness of the lamp. This will cause an increase in the resistance of the LDR which in turn increases the voltage applied to the primary of transformer of SSVAA whose secondary will 'boost' the output to the normal value. The LDR and the lamp must be enclosed in a light-impermeable capsule.

The circuit described boosts the voltage in case it goes below the normal value. But in case the voltage goes above normal, bucking action can also be incorporated.

The circuit for incorporating the bucking action using T3 and T4 is shown in Fig. 2. The secondary of output transformer of the boosting unit is in phase with the input, whereas the secondary of the output transformer of the bucking unit is connected in phase opposition. Both the secondaries are connected in series. The dots marked over the windings of transformer in Fig. 2 represent the polarity of the windings of transformers.

The voltage across the LDR (R4) of the boosting unit is controlled by lamp L1 whereas LDR (R5) is controlled by lamp L2. The output volt-amp, can be varied by varying the current rating of the secondary winding (W_E) of transformer X2.

The cost of prototype using a 2-amp transformer (X2) is about Rs 300 only. If bucking action is also incorporated, the cost will come to around Rs 400. □

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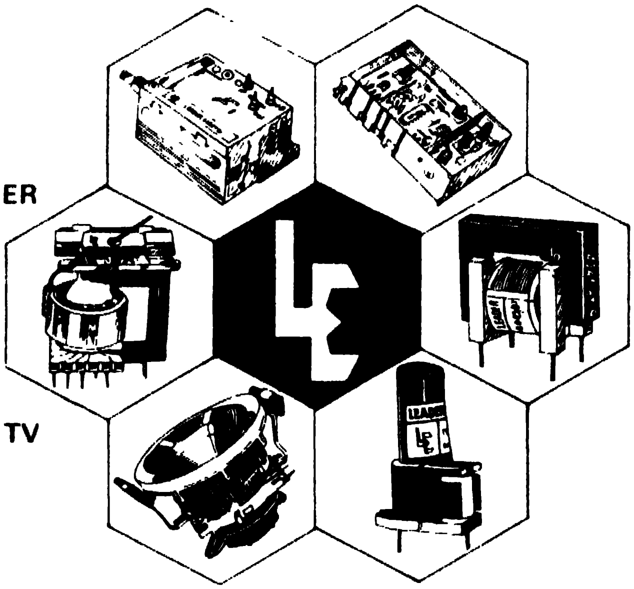

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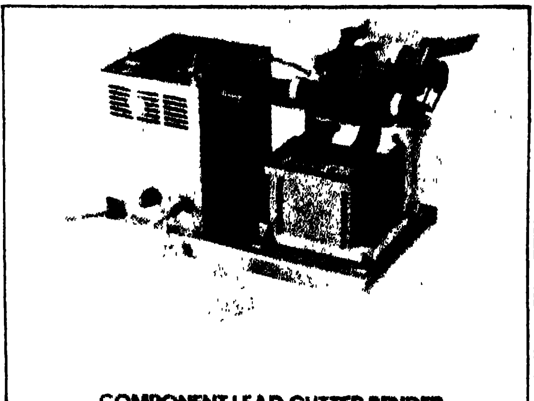

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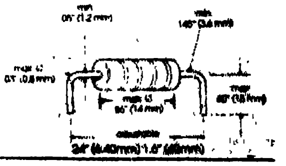
This precision axial component lead bender delivers thousands of accurately formed components just by turning the crank Special low-effort design delivers up to 25,000 taped or 1200 loose, ⅛ watt to 1 watt parts per hour, production rates usually associated only with automatic machines. The CB-1 protects components from mechanical stress and prevents axial tension on delicate diodes The operator can adjust lead spacing from .240 inch (6mm) to 1.60 inch (40 mm) with bends as close as .050 inch (1.2 mm) from the body, and can adjust cut length independently from .145 inch (3.6 mm) to .600 inch (15mm)

An electric motor attachment, model CB-3, is available as an option and enables the CB-1 to deliver perfectly formed parts at variable rates of 20,000 to 40,000 per hour. The CB-3 also keeps track of the number of components formed via a built-in counter, especially useful both for production control and for "kitting" parts prior to assembly



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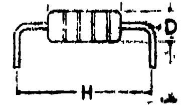

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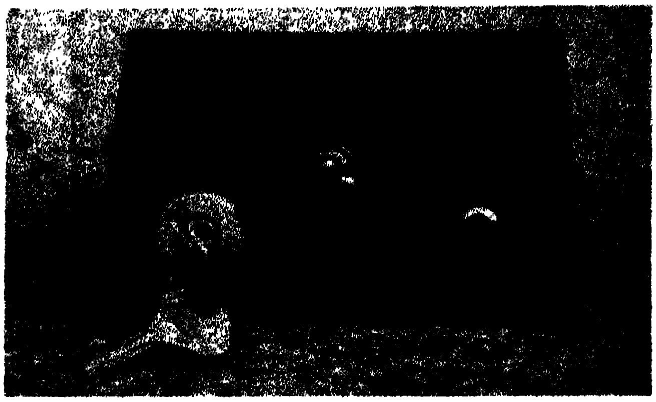

STD/Local Bar to Prevent Overcharging

P. Jayavardhana Krishnan

Overcharging of telephone bills is not an uncommon occurence in India. Often in offices, business houses and even at homes, telephone subscribers are faced with unbelievably inflated bills. In spite of taking certain precautions, subscribers have not been freed of this menace.

Many attempts have been made and devices developed to arrest overcharging of bills. One such device is described in this article.

This device when switched to STD OFF, LOCAL OFF position, disables the telephone from STD and local dialling facility, when switched to STD OFF, LOCAL ON position disables the telephone from STD facility but enables the telephone for local dialling and when switched to STD ON, LOCAL ON position enables the telephone for both the STD and local dialling. Thus STD and local facilities can be turned on or off as and when required and use of the instrument in proxy can be avoided which may cut overcharging considerably.

However, this device does not interrupt incoming calls. It can be connected to any type of telephone instrument, either pushbutton type or dial type. The connections to this device are also simple. Just connect the incoming line from exchange to the terminals marked INPUT of this device and OUTPUT to the telephone instrument with proper polarities.

This device is allowed by the P and T Department. However, readers are advised to get the prior permission of the telephone authorities before assembling the device.

The circuit

This device is designed around CMOS IC for increased longevity of the battery. The heart of the circuit is the synchronous decade counter/decoder IC CD4017. It counts the number of positive going pulses received at its clock input and provides a high output on its decimal decoded outputs (DDO) corresponding to the decimal equivalent of the former.

IC CD4093B is a quad two input NAND schmitt trigger with UTP (upper triggering point) about 6V and LTP (lower triggering point) about 4V. This IC is used to shape the pulses received from the telephone instrument during dialling to meet the clock pulse requirements of IC2 for its reliable operation.

Zener D5 is used to isolate gate 1 of IC1 from the battery of exchange during inter-digital pause and during dial-tone. Whenever a number is dialled, D1 and D5 conduct and the voltage at the input of gate 1 goes well above UTP.

Gate 2 inverts output of gate 1. C1 prevents Vin from going below LTP during inter-pulse period of dialling. Thus, whenever a number is dialled, a positive going pulse appears

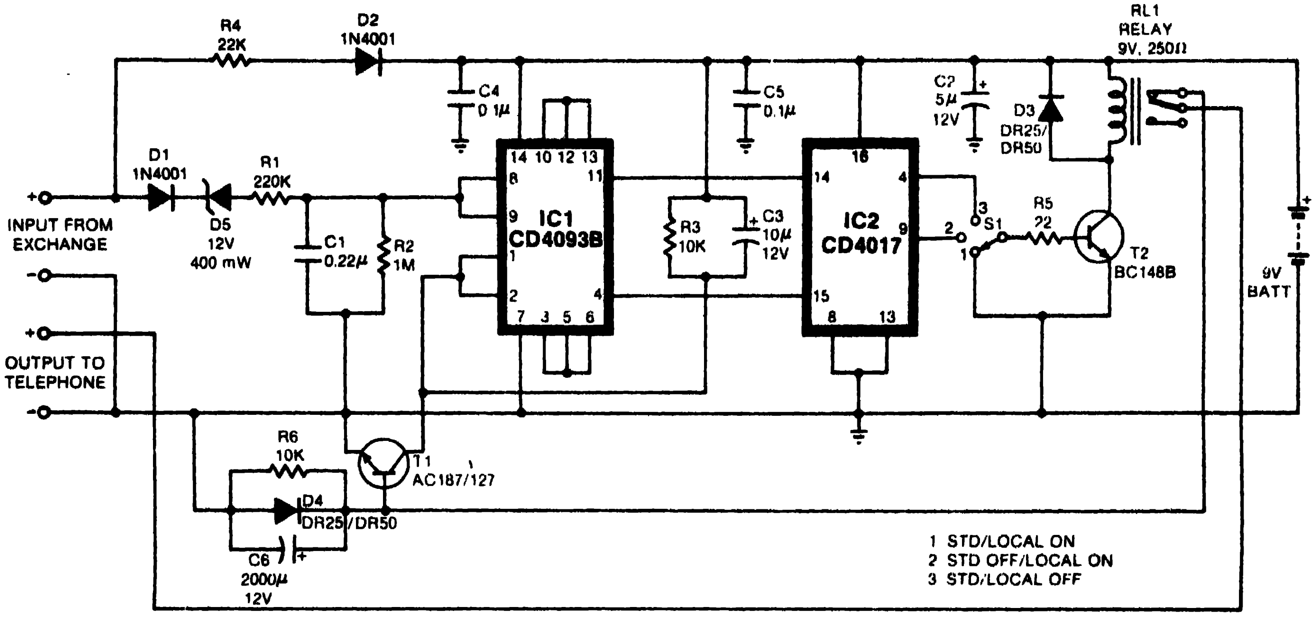

Fig. 1: Circuit diagram of STD/Local Bar.

PARTS LIST

Semiconductors:	
IC1	CD4093B quad 2-input NAND gates
IC2	CD4017 decade counter
T1	AC187/AC127 npn germanium transistor
T2	BC148B npn silicon transistor
D1, D2	1N4001 rectifier diode
D3, D4	DR25/DR50 germanium diode
D5	12V, 400mW zener diode
Resistors (all ¼watt, ±5% carbon):	
R1	220-kilohm
R2	1-megohm
R3, R6	10-kilohm
R4	22-kilohm
R5	22-ohm
Capacitors:	
C1	0.22µF ceramic disc
C2	5µF, 12V electrolytic
C3	10µF, 12V electrolytic
C4, C5	0.1µF ceramic disc
C6	2000µF, 12V electrolytic
Miscellaneous:	
S1	3-way auto ignition switch
RL1	9V, 250-ohm relay
BATT.	9-volt, Eveready 216 battery
	PCB, IC sockets, enclosure, banana socket, connecting cable, flexible wires etc.

at the clock input (pin 14 of IC2), thereby advancing the counter output by one decimal number. The time constant R2 C1 is so chosen that during inter-digital pause Vin falls below LTP and clock input of IC2 becomes high, thus facilitating the operation of IC2 for the next digit of telephone number.

T1 is used for resetting the counter. Whenever the cradle switches are pressed, base-bias to T1 is removed and reset terminal of IC2 goes high after a short delay (due to time constant R3 C3) which is used to prevent resetting of IC2 to zero during dialling, ultimately resetting IC2 to zero.

In India, the minimum total number of digits for STD is 8. Hence when this device is switched to STD OFF, LOCAL ON position, upon the dialling of 8th digit, DDO Q8 of IC2 goes high which in turn energises the relay. The relay then disconnects the telephone temporarily for a few seconds and again connects it to the exchange after IC2 is reset to zero due to removal of bias to T1. Since this operation is similar to the operation performed by cradle switches, dial-tone is heard on the ear-piece.

One may think that this operation may be performed at the lower digits of the telephone number itself. But this is not possible in the STD OFF, LOCAL ON position since the telephone is barred for local calls too for cities like Bombay and Delhi which have as many as 7 digits for the local numbers.

In STD OFF, LOCAL OFF position, similar operation would take place when the second digit of telephone number is dialled.

In the STD ON, LOCAL ON position T2 will be completly isolated from IC2, thereby enabling the subscriber to dial without any bar. During incoming calls every ring generates a pulse to appear at the clock input of IC2 but during interruption of the ring, DC on the telephone line is absent, T1 is cut-off and so IC2 is reset to zero. Thus during the incoming calls, the maximum pulse possible is one, which is well below the required number of pulses for the operation of this device.

D2 in series with R4 trickle charges the battery used to improve its working life. C4 and C5 are the decoupling capacitors which must be mounted close to pins 14 and 16 and ground terminals of IC1 and IC2 respectively. C6 provides sufficient delay for the release time of relay so that the exchange switching systems reset and restore the dial-tone.

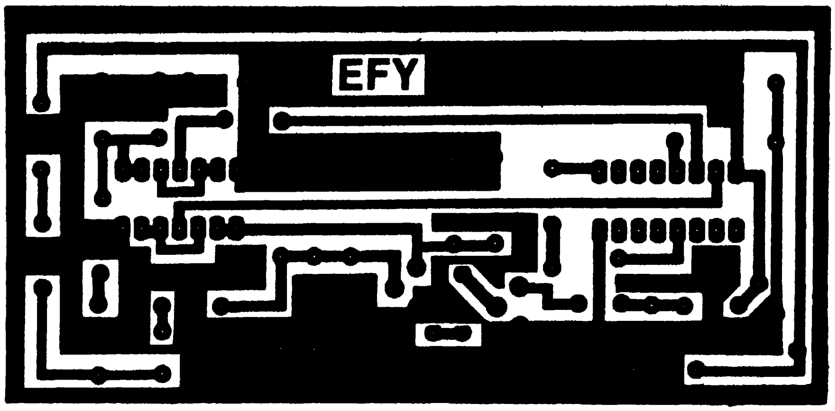

Fig. 2: Actual Size PCB layout for STD/Local Bar.

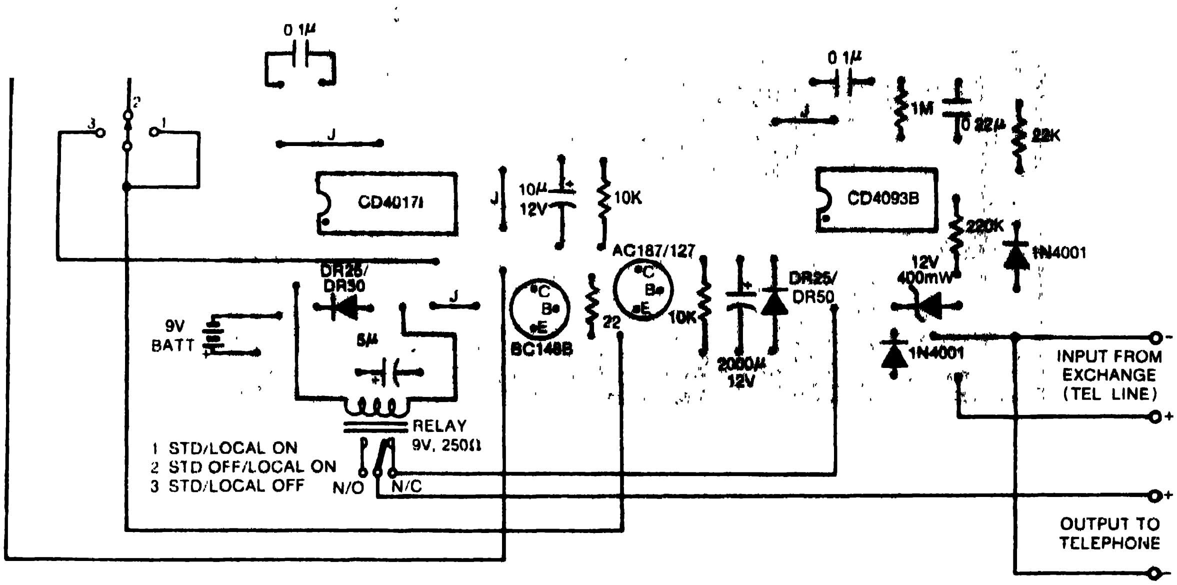

Fig. 3: Component layout for the PCB.

Construction

The prototype is assembled in a general-purpose IC board. However, the suggested PCB pattern is also given here. For switch S1, an automobile ignition switch with three positions is used. Such a switch proves useful because it may be put in the position desired and the key removed. The prototype is housed in a verobox of size 154(L) × 85(W) × 40(H) mm and battery of type Eveready 216 is used. ☐

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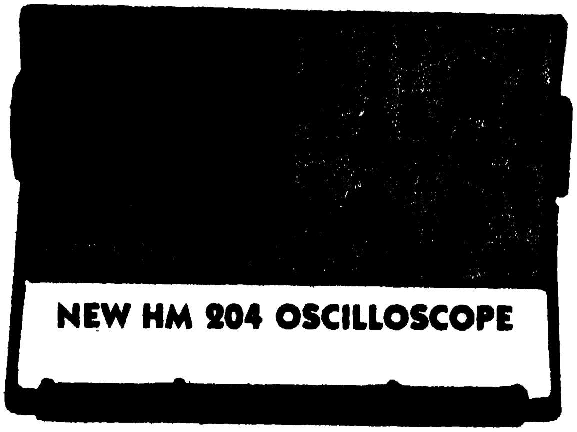

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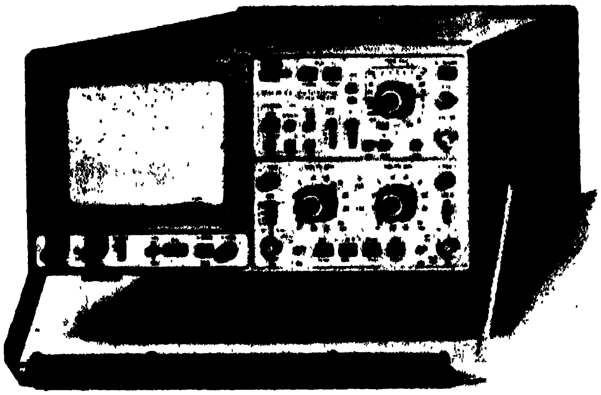

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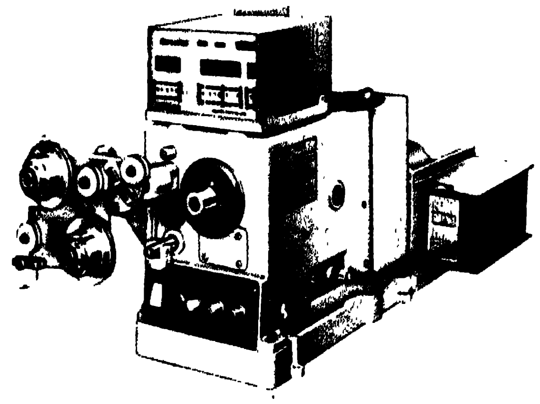

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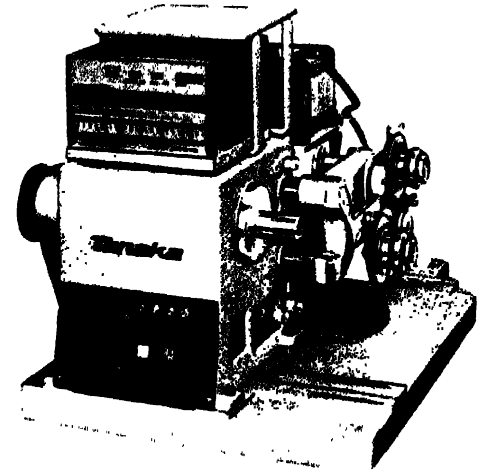

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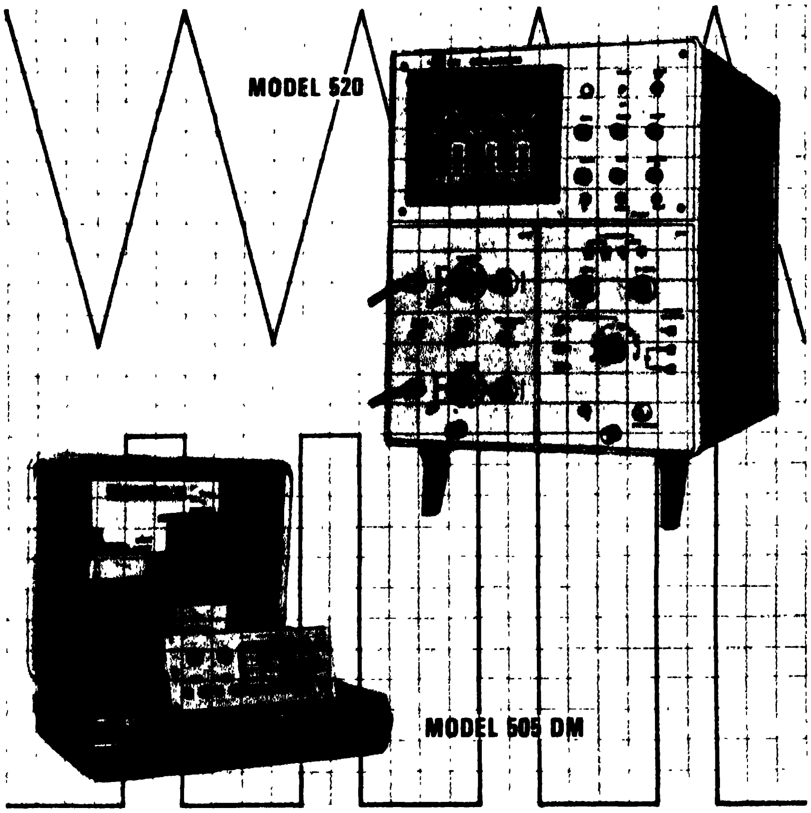

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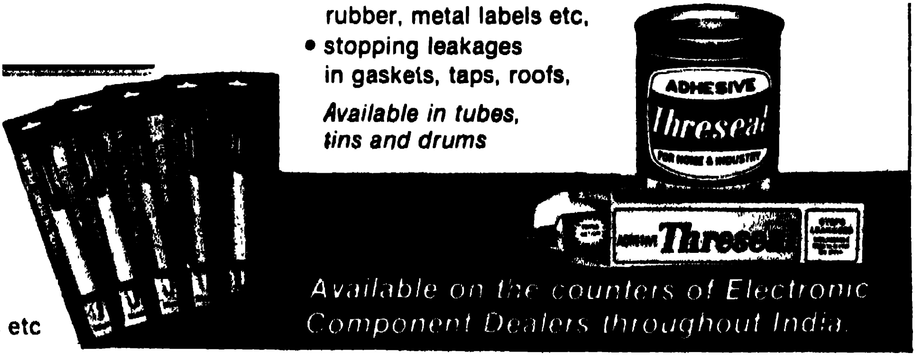

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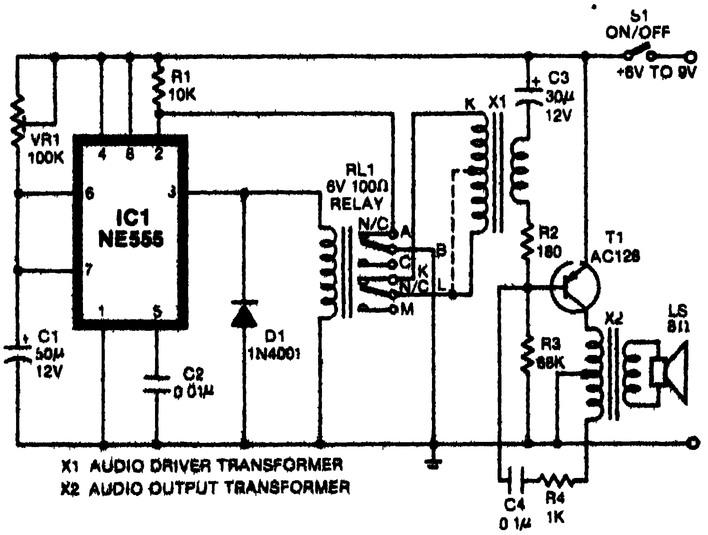
Bird Sound Generator with Timer

Most people have heard parrot bell or bird bell It produces sound as that of parrot repeatedly The circuit described here uses a timer along with the 'parrot' circuit to produce a very pleasing sound, as that of parrot or bird Repetition rate of sound is automatically varied due to the timer circuit This circuit will cost about Rs 50 only Power consumption for this circuit is 15 mA at 6 volts.



Pin 2 of IC 555 is connected to relay RL1's terminal A. Terminal B of the relay is connected to ground, and relay terminals K and L are connected to two opposite terminals of the driver transformer X1.

As soon as switch S1 is pressed, relay operates for particular time interval. This opens the opposite two terminals of the driver transformer and changes repetition rate of sound of the parrot bell After one to three seconds, the relay will be in off state and thus short the two terminals of driver transformer and again change the repetition rate of sound of the parrot bell circuit. Preset VR1 may be adjusted for a variation in the sound.

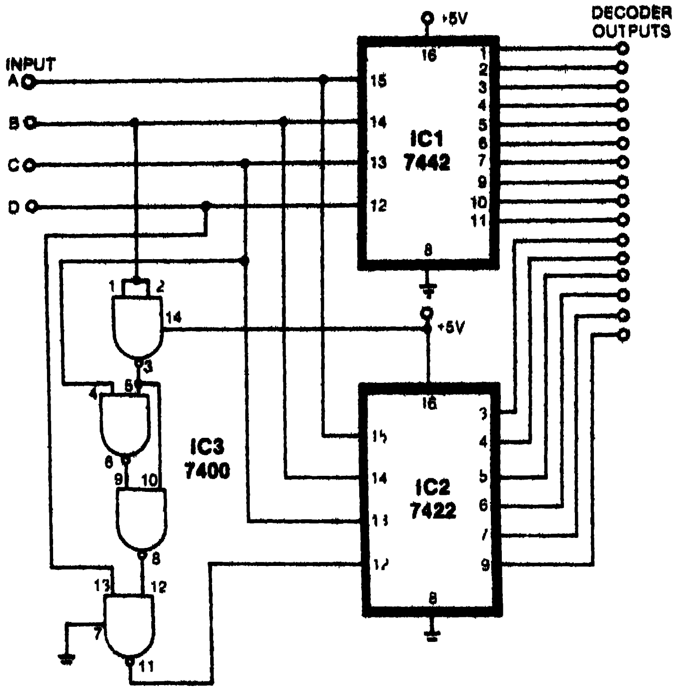
Repetition rate can be changed as per choice by replacing capacitor C3 with another value. The effect of using center terminal of driver transformer should also be observed

(During evaluation of the circuit in EFY lab, it was observed that changing the value of C3 to 100µF and connecting a 68-ohm resistor in series with the speaker produced a 'real' parrot sound. And repetition rate of the sound changes with slight variation in DC supply voltage.)

PROF. R.V. DHEKALE

Cost-effective 4-line to 16-line Decoder

Decoders are commonly used ICs in digital circuits. Most popular decoders in the TTL family are 7441, 7442 and 74154. IC 7441 and IC 7442 are 4-line to 10-line decoders. IC 74154 is a 4-line to 16-line decoder/multiplexer



TRUTH TABLE

INPUT				OUTPUT OF IC1										OUTPUT OF IC2					
D	C	B	A	1	2	3	4	5	6	7	9	10	11	3	4	5	6	7	9
L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	L	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	H	L	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	H	H	H	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H
L	H	L	L	H	H	H	H	L	H	H	H	H	H	H	H	H	H	H	H
L	H	L	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H	H	H
L	H	H	L	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H	H
L	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H
H	L	L	L	H	H	H	H	H	H	H	H	L	H	H	H	H	H	H	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H	H
H	L	H	L	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H
H	L	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H
H	H	L	L	H	H	H	H	H	H	H	H	H	H	H	H	L	H	H	H
H	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H	H
H	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L

Whenever the design needs 4-line to 16-line decoding, the experimenter is forced to use IC 74154 as there is no other IC available in the market. The cost of IC 74154 is Rs 60 to 70, which is rather high compared to the cost of normally used

ICs. Hence it is well justified to use a low-cost circuit for 4-line to 16-line decoding in the place of IC 74154.

The circuit described here uses three TTL ICs. Though a bit more of wiring effort is involved, the saving in terms of cost is considerable. The circuit should cost about Rs 25 only. (Rs 20 for two numbers of IC 7442 and Rs 5 for IC 7400).

Circuit shows the wiring of two IC 7442s to obtain 4-line to 16-line decoding function. IC1 decodes the 4-bit input in the conventional manner- -from 0 to 9. For inputs beyond 9, all the outputs of IC1 remain high. All the outputs of IC2 remain high for inputs from 0 to 9. Inputs beyond 9 are decoded by IC2 giving outputs (LOW) from 10 to 15 on pins 3 to 7 and 9. The drive logic for IC2 is provided by IC3. The truth table for the circuit is also shown.

T.K. LOKABHIRAM

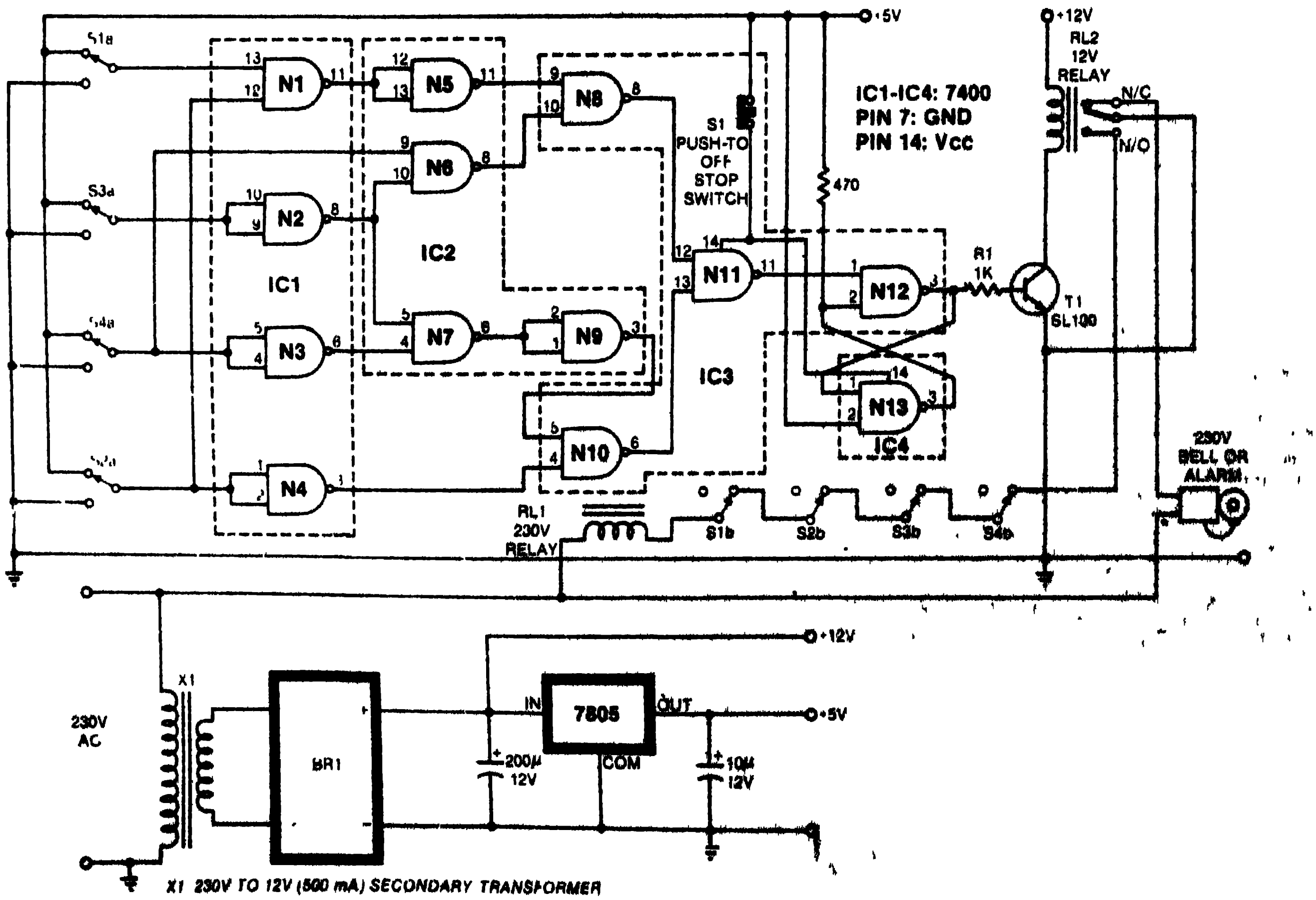
Digital Combination Lock

There are several types of combination locks available but most of them are mechanical. Here is a digital electronic combination lock which is much more reliable than the readily available mechanical combination locks. One can open a mechanical combination lock by trying again and again. But this electronic combination lock gives only one chance to open it as it includes an alarm and an auto-cut-off system.

One has to close four switches in a definite sequence to open the lock. (In the circuit shown here, the switch closing sequence has been pre-set as S1, S2, S3 and S4 respectively.) In case a wrong switch is closed, i.e., if this sequence is not

TRUTH TABLE

INPUT				OUTPUT
A	B	C	D	
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	1



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followed strictly, the alarm will start ringing and alert everyone nearby. The alarm will continue until the stop switch S1 is pressed. And the lock will not open even if the right sequence is followed immediately thereafter This will definitely scare away any thief.

The circuit is built with four SN7400 NAND gate ICs. These TTL ICs are cheap and easily available in the market

The truth table is also shown. By using K-map, we get the logic function

$$F = A.B(C+\overline{D}) + \overline{B}.\overline{C}.\overline{D}$$

Here it is evident that there are five combinations of inputs for which output becomes '1'. That means for these combinations, the alarm will not ring.

The four SN7400 ICs may be soldered on a veroboard and connected as shown in the circuit diagram. Four input cords with jack pin on one side are needed. The jack pins should be of different colours. Switches S1a, S2a, S3a, S4a and S1b, S2b, S3b, S4b are ganged respectively. Switches S1b, S2b, S3b, S4b are in series with relay RL1 which opens the lock Different identification numbers (or letters) may be put on all the switches

The output is available at pin 3 of IC3. The SL100 transistor activates the relay as soon as it gets an input at its base. The flip-flop built by NAND gates N12 and N13, once activated, remains in the same state. Hence T1 and RL2 also remain active until switch S1 is pressed. The alarm will continue to ring and relay RL1 remains disconnected from the mains.

The power supply circuit is also shown in circuit diagram. A 230V/12V, 500mA power supply transformer and IC 7805 voltage regulator have been used to get a steady 5V DC supply. When activated, the alarm gets connected to 230V mains. Total cost of the unit is around Rs 85.

NILANJAN BHOWMIK

Automatic Brightness Control for Seven-Segment Digital Displays

Here is a circuit which exercises automatic brightness control on LED displays of digital clocks, and for that matter on any seven-segment display unit depending on the ambient lighting conditions.

The basic principle underlying this circuit is the 'on-off control' method of regulating the voltage and hence the brightness. The relationship portraying this is given by·

$$V_{OUT} = V_{IN}\frac{T_{on}}{T_{on}+T_{off}} = VD$$

where V_{OUT}—average/DC output voltage

V_{IN} – input voltage

D – -duty-cycle

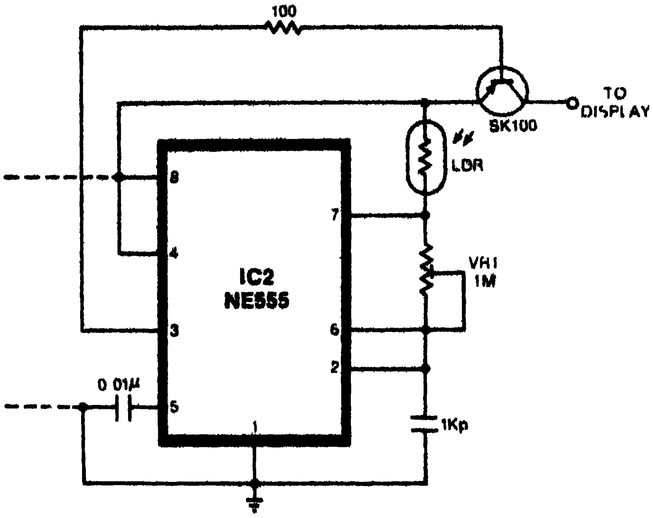


Fig. 2:

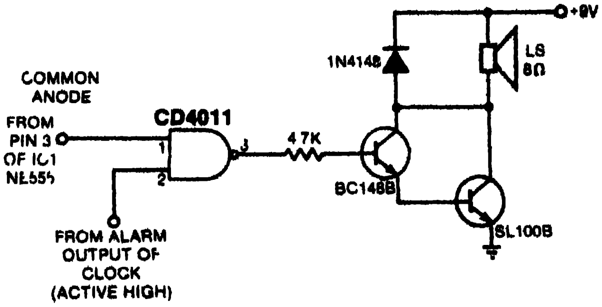
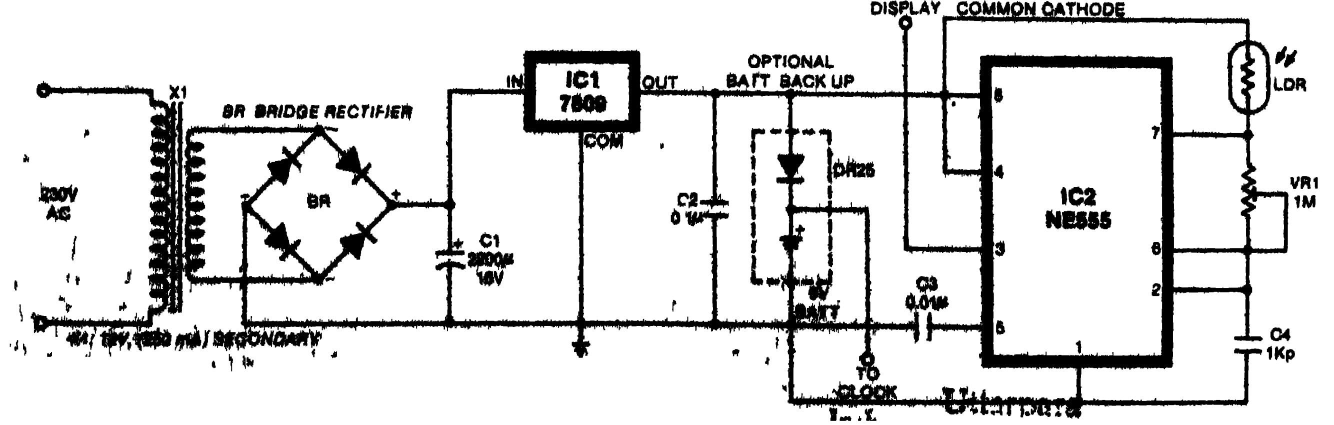


Fig. 3:



T_{on} -time when $V_{OUT}=V_{IN}$

T_{off} time when $V_{OUT}=0$.

As seen from the equation above, one can control the average DC voltage and hence brightness by varying the duty cycle

To implement this idea, IC 555 as chopper and an LDR to sense the ambient light are used

The circuit in Fig 1 is for common cathode displays and that in Fig. 2 for common anode displays VR1 is trimmed for optimum display brightness under normal ambient lighting conditions

Besides brightness control, this circuit provides regulated output voltage over a wide range of input voltages

The main advantage of this unit over the conventional one is the reduction in mean display current and power dissipation in the series-pass elements of regulating units as the voltage is bucked from a fairly high voltage to the required display voltage

The circuits shown above are capable of delivering currents upto 200 mA However, this capability may be increased using higher current handling transistors in place of the existing ones

Fig 3 is an extension of the circuit It is a current driver coupled to a speaker to produce an audible clarion note when the alarm set time is executed

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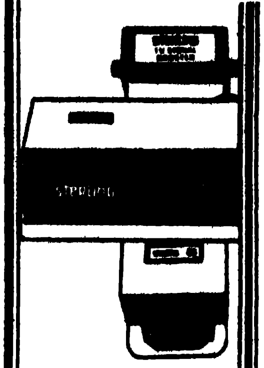

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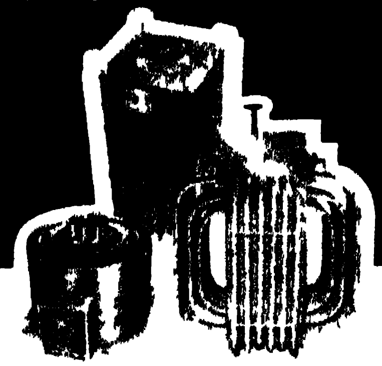

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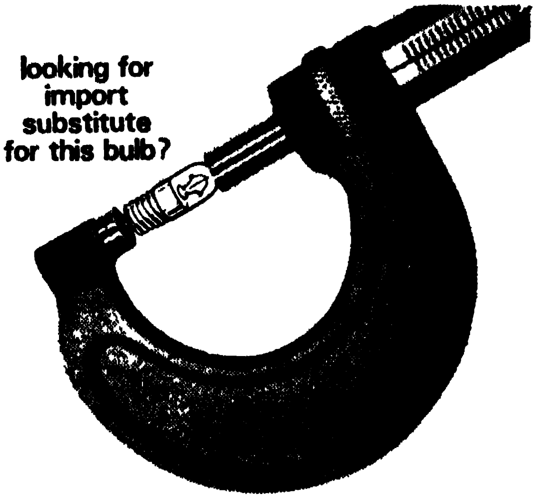

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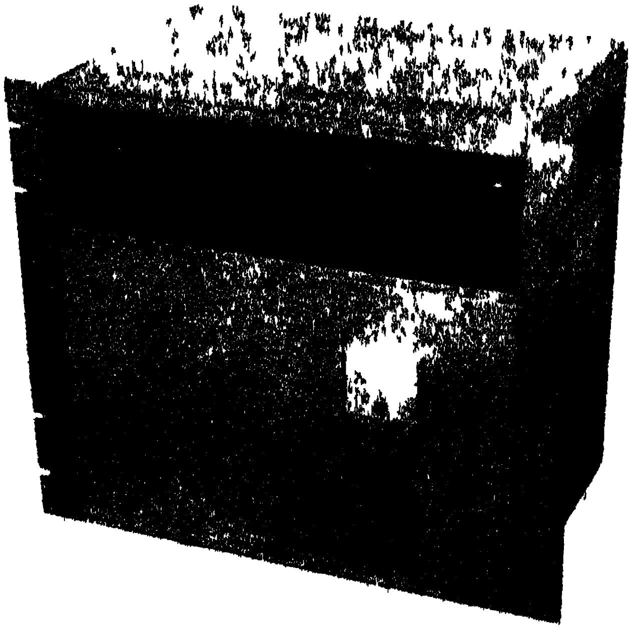

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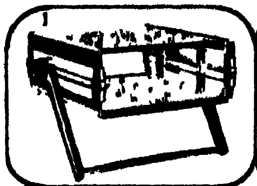
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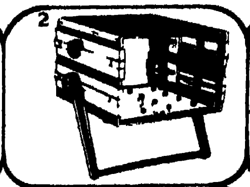
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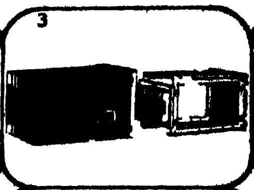
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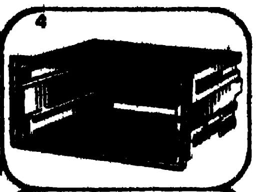
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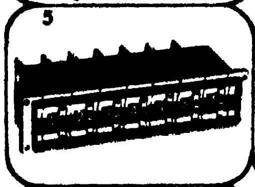
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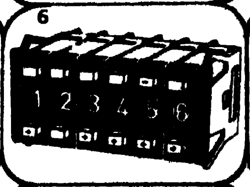
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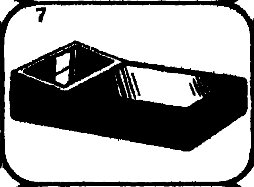
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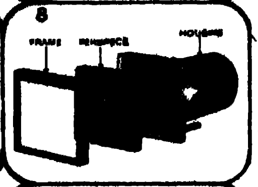
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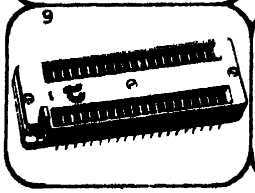
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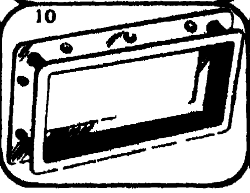
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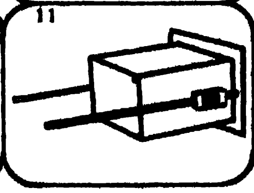
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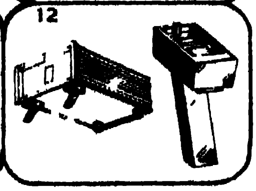

12

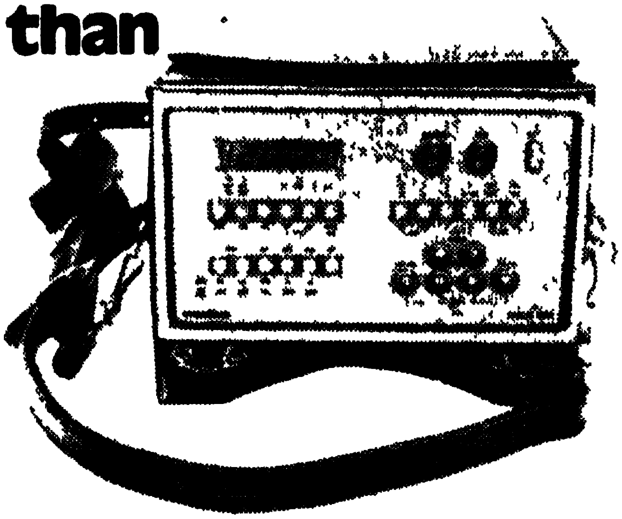
1 Instrument Case T 220 For Digital Table Top Test Instrument
2 Instrument Case T 220 H H = 145 MM. For Analog Instruments
3. DIN STD Instrument Case + Cassette 96 × 96 × 150
4 Instrument Case 96 × 48 × 90 ½ DIN STD
5 Thumb Wheel Switch T 21
6. Coded Push Button Switch T 24 T—24 W = 76 mm
7 Hand Held Instrument Case T 29 29 × 81 × 145
8 Annunciator Kit T 54 54 × 54 mm
9. Zero Insertion Force 40 Pin DIL IC Socket
10 Bezel For 3½ Digit
11 Instrument Clamp IC 200
12 Instrument Rest Kit T—13

For more information contact

COMPONENT TECHNIQUE

8 Orion L P Road Andheri (W), Bombay-400 058 **Tel: c/o 4224066**

When you must rely upon a great D.C. Calibrator you can't do better than MASIBUS UNICAL 3001



Salient Features

- Choice of simulating or measuring 7 ANSI standard thermocouple types and Pt-100 RTD in °C
- Microprocessor based linearised design for long term accuracy and reliability
- Software controlled AUTOCALIBRATION LOOP ensures long term accuracy
- Also measures and simulates DC mV and mA
- Facility for factory programming to include two additional thermocouples & RTD types each as per customer's standards
- Automatic selectable Cold Junction Compensation built-in
- Mains or built-in rechargeable battery operated
- Suitable for field and laboratory work

Existing family of Masibus D.C. Calibrator Models 1001 2001 2001A and 2001M are the "first" choice by users simulating/measuring mV/mA, resolving right upto 1μV DC and displaying them in 3½/4½ digit LED's they are the "market leaders" today

Call or write to us for further details **MASIBUS ELECTRONICS**
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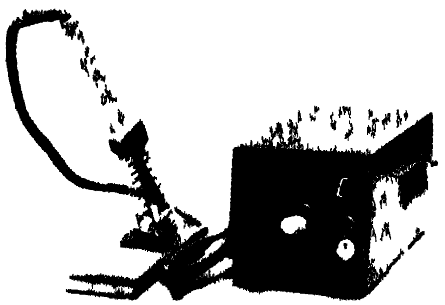
DEALERS *TUSHAR ENGG ENTERPRISES 21/C Eastern Society Fatehganj, Baroda 390002 * INDUSTRIAL RESEARCH ASSOCIATES, 302 Acharya Comm Centre Chembur Bombay 400074 *NUCLEAR SCIENCES, 48, Lenin Sarani, Suite No 7, 1st Floor, Calcutta 700013 Phone 212757 *ASIATIC ENGG CO P B No 4 Vytilla Cochin 682019 *DIGITAL PROMOTERS, 106, Sahyog, 58, Nehru Place, New Delhi 110019 Phone 6437649 *UDAY INSTRUMENTS INTERNATIONAL, 13-A, Second Cross St, Venkatesapuram Colony, Ayanavaram Madras 600023 *RESIDENT REPRESENTATIVES in Bangalore, Hyderabad

Product Profiles

This Temperature Controlled Soldering Station with a 3-digit LED display enables supervision of the actual working temperature of the tip of the soldering iron The temperature of the bit can be varied from 120°C to 450°C Resolution and settability is as high as 1°C



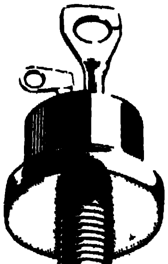
SOLDERING STATION

Power unit is isolated from mains which works on 24 V to avoid any voltage spike or magnetic field Temperature setting can also be done digitally

Contact: Reliance Electronics, 67 Industrial Suburb, Yeshwantapur, Bangalore 560022

FAST SWITCHING THYRISTORS

SPE has developed high voltage Fast Switching Thyristors in its SPSI range of 10 to 16 amps (AV) current The inverter grade SCR is available in the voltage range upto 1600 volts V_{RRM} and V_{DRM}, with turn-off type range of 10 to 25 µsec, at applied voltages This fast thyristor is available in TO-48 casing, as well as isolated type casing. The above rating is also available in fast switching thyristor-diode isolated modules as well as in fast switching thyristor-thyristor isolated modules.



FAST SWITCHING THYRISTORS

Contact: [illegible] Power Electronics, [illegible] Nagar, Pune 411016.

[illegible]

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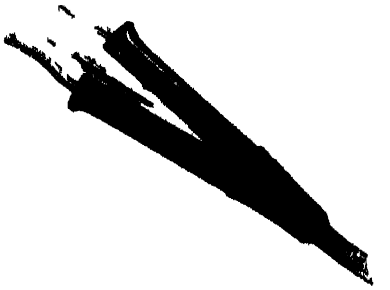


THERMAL WIRE STRIPPER

even toughest thermoplastic insulation material Construction is made rugged through modern processes Unlike conventional mechanical strippers it does not require frequent adjustments for wires of different diameters and so is suitable for operation even by an inexperienced operator It can strip wires of a wide range of sizes ranging from 0 1 to 7 5 mm diameter Strip-stop slide is provided to adjust length of insulation to be stripped This provision facilitates uniform stripping where desired in production run Unit operates on 240V AC supply and thermal settings are provided so as to ensure that blade temperature is just sufficient to soften the insulation without discolouration or burning

Contact Sai Electronics, (A Div of Starch & Allied Industries), Thakor Estate Kurla-Kirol Road, Vidyavihar (West), Bombay 400086

TRIACS

TRIAC, acronym for Triode (three electrode) AC semiconductor switch, is triggered into conduction by a gate signal in a manner similar to the action of an SCR Triacs are available in current ratings up to 100 amps and voltage up to 1200 volts with various hermetic metal packages These can block voltages in either direction, conduct current in either direction and be triggered in either direction by positive or negative gate signals

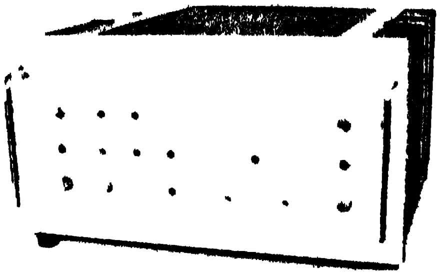
TRIACS

Triacs are being manufactured with high-reliability silicon chips having high dv/dt selection, low switching loss, low thermal resistance and special testing of I_{gt}, V_{gt}, dv/dt, TJM which give longer life and high reliability to the device.

Contact: Solid State Electronics Co. Pvt Ltd., Plot No. 9/123, Marol Co-operative Indl. Estate, P.O. Box No. 7432, J.B. Nagar, Bombay 400059

UPEX SYSTEM

The UPEX system consists of a solid-state sinewave inverter a sophisticated battery charger and an electromagnetic changeover relay The basic function of this UPEX system is to supply continuous (no-break) power to a telex machine and its accessories Normally the power to the telex machine is supplied by utility mains supply However when it fails the user loses the number obtained with great difficulty and prolonged dialling and also wastes a lot of time to obtain the link again



UPEX SYSTEM

UPEX switches over the supply to the machine on the inverter, which takes full load of the machine without loosing a single letter of the outgoing or incoming message

Contact Spectron Sales & Service Pvt Ltd 63 Bharatkunj No 2 Erandvane Pune 411038

PRINTING-CUM-LABELLING MACHINE INKS

Suvichem Inks manufacture ink for hand-held printing-cum-labelling machine to be put in foam pads which constantly ink the numbering wheels The ink penetrates the pad and the pad stays moistconstantly The ink is applied on the smooth surface and not on porous surface Available in black colour Precision recording inks pad inks metal marking inks, carton marking ink and ink sacs are also manufactured to meet the diversified Indian market Many of the inks developed are import substitutes

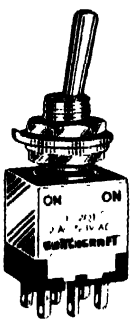
Instrument felt pad ink is used for recording in those instruments where felt is used to absorb ink in place of ink bottle or ink capsules The ink is indelible and stays for long although it dries on paper immediately The ink is available in red, green, blue, black, violet and Orange colours

Ink Sacs in PVC for recording instruments are available in sizes as per customer requirement and are suitable for Baileys (USA) and other recorders They are available in different colours, viz, red, green, violet, orange, blue, yellow, brown, purple, etc 'Suvichem recording ink is used in these sacs and is available in packings of 10/20 or 50 in one Box. All the ink Sacs are individually packed in plastic self closable bags

Contact: Arora Enterprises, 301, Sheth Chamber, Narimata Street, Raj Mahal Road, Bombay 400001.

MINIATURE TOGGLE SWITCH

This switch is suitable for electrical and electronic instruments and equipment It is rated for 2A-250V AC, with centre 'Off' position of dolly knob The main features of the switch are deep drawn brass casing which encloses the inside mechanism totally and thus protects it from dust and moisture, and moulded-in terminals which keep the base absolutely free from cracks and also eliminate the solder



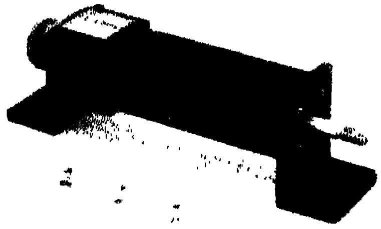
MINIATURE TOGGLE SWITCH

flux contamination during soldering operation The contacts are made of copper The switches are supplied with mounting hardware

Contact Switchcraft, 54/55, Crescent Mansion, Gamdevi Road, Bombay 400007

ENCODER

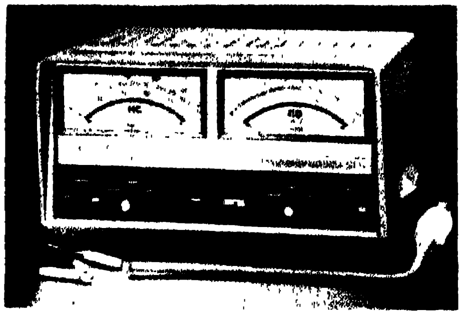
This new Encoder is an absolute position device, translating shaft positions directly into specific binary numbers So loss of power will not result in loss of data Outputs are in binary, BCD or gray code, directly compatible with the computer, requiring no signal conditioning, buffering amplifiers, or squaring circuits All models with 12" stroke length or less have 256 counts to the inch Life expectancy is 10 to 30 million cycles



This can be mounted directly on robots, milling machines drill presses, material handling equipment, and the like, because it is extremely rugged, and resistant to shock and vibration

Contact. Al-Tronics International, 243, Dr Cawasji Hemusji Street, 3rd Floor, Bombay 400002.

INFRARED EXHAUST ANALYSER



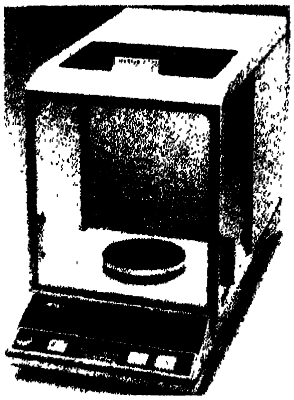
INFRARED EXHAUST ANALYSER

The Infrared Exhaust Analyser manufactured by Sun Electric Corporation, USA quickly and accurately measures the carbon monoxide (CO) and unburnt hydrocarbons (HC) in the exhaust of automobiles operating on petrol. CO up to 10 per cent and HC up to 2000 PPM can be measured with this analyser It is a light and portable instrument operating on 12V automobile battery Fast response time and display on large back-lit meters makes measurement quick and easy A flexible probe ensures insertion in any exhaust pipe Altitude compensation switch is provided on the back panel

Contact. A.T.E Pvt Ltd, Electronic Equipment Divn, 43, Dr V B Gandhi Marg, Bombay 400023.

ELECTRONIC ANALYTICAL BALANCES

A&D Company, Japan has just introduced a new series of electronic analytical balances with capacities of 180g, 120g and 60g and a resolution of 0 1mg They have an automatic calibration system that uses an internal reference weight and a microcomputer with a non-volatile memory for exceptionally fast and easy calibration



ELECTRONIC ANALYTICAL BALANCES

The weighing chamber of these balances open on both sides and the top Other features include one-touch tare up to capacity, a liquid and dust-proof keyboard, a clear easy-to-read cobalt-blue display and under-balance weighing capability.

Contact. Universal Biochemicals, Enzyme House, 6 Sathya Sayee Nagar, Madurai 625003

12-BIT DAC AND VOLTAGE REFERENCE

A 12-bit Digital-to-Analogue Converter (DAC) and a precision Voltage Reference from Analog Devices are the first such devices to be listed on the Defence Electronics

12-BIT DAC AND VOLTAGE REFERENCE

Supply Centre (DESC) Qualified Parts List (QPL) which guarantees standard device configuration, performance and reliability

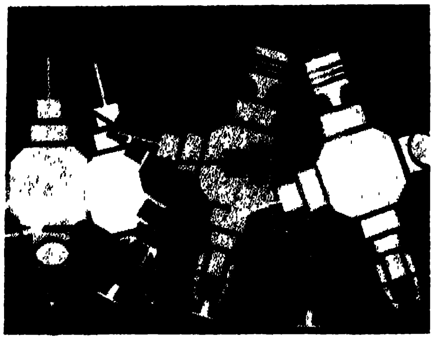
The AD 562 and AD 584 undergo extensive quality conformance inspection (groups A, B, C and D) comprising electrical screening, mechanical testing of the packaging, and 1000 hours of life testing.

The AD562, listed on the QPL by JAN (Joint Army Navy) part number JM38510/12101BJC, is packaged in a 24-pin ceramic DIP Two versios of the AD584 are available both packaged in a TO-100 metal can package

Contact C.H Krishnan & Associates Pvt Ltd, Kamal Theatre Building, Safdarjung Enclave, New Delhi 110029

ANOROBOTS

ANORAD Robots are noted for a variety of applications involving precision and increaing productivity Automatic operation of work performing devices, numerically controlled placement of component, operational dexterity to manipulate an IC chip or large loads are



ANOROBOTS

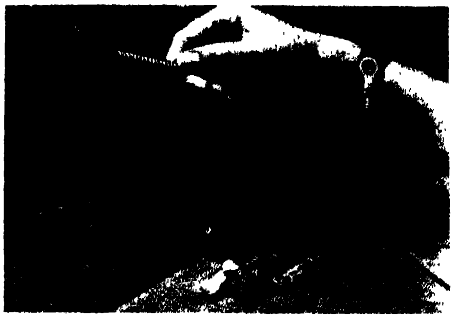
some of the features of Anorad robots.

Contact. Echbee Corporation, Kamer Bldg, 38 Cawasji Patel Street, Bombay 400001.

STATIC CONTROL PRODUCTS

Vermason Limited, England offers a wide range of conductive materials and products for the protection of electrostatic sensitive devices from unwanted static charges in assembly, test and inspection, storage and transport and repair or replacement on site.

To minimise the risk of static damage to devices used in electronics industry, special handling areas (SHA) are essential. All articles and surfaces in the SHA must be conduc-



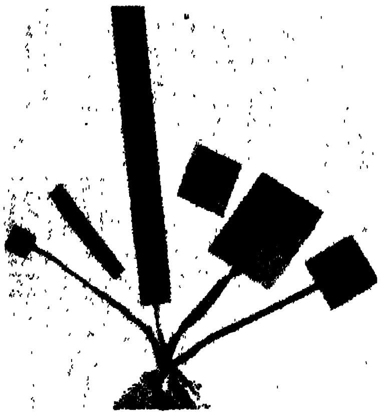
STATIC CONTROL PRODUCTS

tive to ensure that all items remain at equal potential. All Vermason anti-static products are electro-conductive, are not dependent on humidity or other climatic factors for their effectiveness and are permanently conductive for the life time of the material

Contact. Electronic Control Components & Devices. 5, Mangoe Lane, Calcutta 700001.

THERMAL-RIBBON TEMPERATURE SENSOR

Thermal-Ribbon Temperature Sensor consists of a wirewound resistance element or a thermocouple junction laminated into a flat configuration between thin layers of flexible insulation The response time is much less than the conventional RTDs and the sensor is ideal for mounting on to surfaces for temperature measurement. It gives fast accurate sensing of air, gas, liquid or surface from -328°F to +500°F



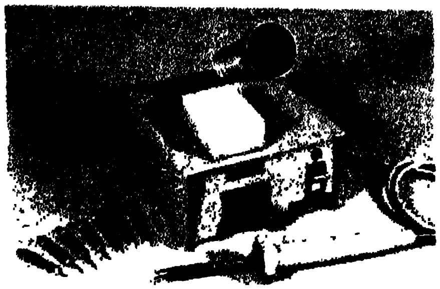
THERMAL-RIBBON TEMPERATURE SENSOR

It finds application in ovens, motors, computer memory planes, process pipeline, medical instruments, refrigeration, electrical components and equipment. They can be supplied with platinum, nickel, copper nickel-iron, RTDs or as E, J, K and T thermocouples.

Contact: Goodwill Cryogenics Enterprises, 213 Nirman Vyapar Kendra, Sector 17, Vashi, New Bombay 400703.

SOLDERING STATIONS

Litesold's temperature controlled soldering system uses a special 5-transistor and op-amp circuit. The power unit provides a controlled low voltage DC supply to the plug-in light-weight soldering iron, in response to a thermocouple sensor located inside the bit Spiking, RFI, hum and magnetic effects are totally avoided The metal power unit case and soldering iron shaft are earthed for screening and static elimination



SOLDERING STATIONS

Temperature selection, between 180°C and 400°C, is done by potentiometer or by tamper-proof selector plugs Soldering irons are interchangeable without recalibration

Contact. HyTech Services, E-96, Greater Kailash-II, New Delhi 110048

HELIUM-NEON LASERS

Melles Griot, Holland offers zero-leak hard-sealed lasers with patented symmetrical cathode design that gives exceptional pointing stability Operating at 632 8 nanometers (red) wavelength, they are provided with brewster window options and give 0.5 mW to 7 mW polarised/unpolarised output power

Depending upon application, a choice can be made between bare plasma tubes and packaged laser heads, with packaged power supplies or modules and self-contained models.

HELIUM-NEON LASERS

Contact: Jainsons Engineering and Electronics Corporation, P.O. Box 5245, Bombay 400009.

LEADLESS CHIP TANTALUM CAPACITORS

STC Components Group, UK launched their new range of Leadless Chip Solid Tantalum Capacitors series TAQ TAQ has been designed for use in thick film circuits and for direct mounting on to PBCs. They are fully encapsulated and very resistant to damage and moisture. The terminals are tin/lead coated and suitable for attachment by dip or reflow soldering. Their small size allows best use of circuit board area, and their format makes them ideal for automatic assembly

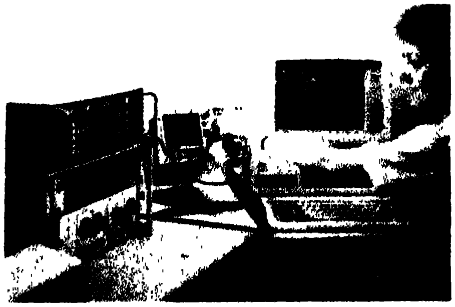
LEADLESS CHIP TANTALUM CAPACITORS

TAQ is available in the voltage range 6.3V to 35V and capacitance 0.1µF to 100µF.

Contact: Jost's Engineering Company Limited, 60, Sir P M. Road, Fort, Bombay 400001.

AUTOMATED OSCILLOSCOPE CALIBRATION SYSTEM

PPM Compucal Series 2000 Automated Oscilloscope Calibration System calibrates all measurement parameters of all types of oscilloscopes up to 1 0 GHz bandwidth, both real time and sampling versions. The system is provided with all necessary hardwares and softwares, depending on required measurement specifications of the users.

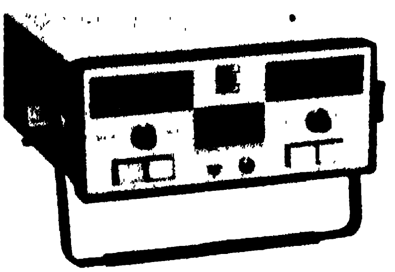


AUTOMATED OSCILLOSCOPE CALIBRATION SYSTEM

Contact: Neotronics International, Post Box 7754, Bombay 400080.

BROOKTRON ELECTROPLATER

Brooktronics Engineering Corporation, USA is manufacturing Brooktron Electroplater. In this electrochemical process, the actual metal deposition (the thickness of which can be precisely controlled with tolerances of ±0.000050) is accomplished by using a 'brush on' action with hand-held stylus (anode) wrapped with an absorbant material, saturated with the plating solution. The cathode is the part which is plated. The system includes



BROOKTRON ELECTROPLATER

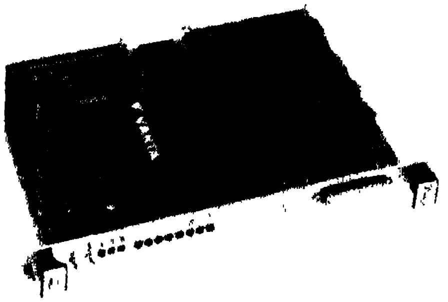
a suitable Brooktron plater as the power supply. Brooktron plating tools and specially formulated plating solutions

This has wide applications in the electronic field for printed circuit boards repairs, besides several other important areas of applications

Contact Professional Electronic and Telecommunication Services, Assisi Nagar, Bombay 400043

CENTRAL PROCESSING UNIT

Force Computers introduces a new, 'no wait state', central processing unit at 12 5 MHz The SYS68K/CPU 4 series of CPUs incorporate the powerful 68010 virtua· processor in addition to a direct memory access controller with up to 128 kBytes of on-board, high speed, static random access memory on one double Eurocard



CENTRAL PROCESSING UNIT

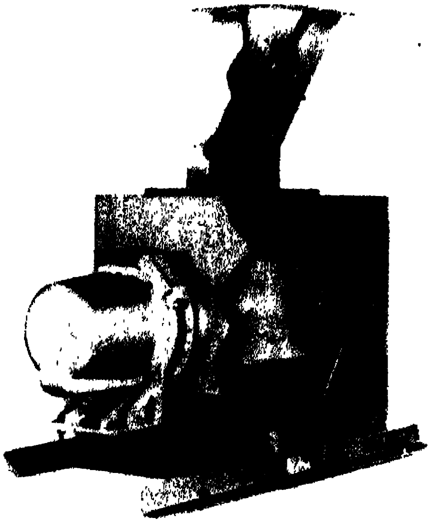
These features, in addition to others, position the SYS68K CPU-4 products for use by professionals who demand high performance in their applications

Contact. SPS Technical Electronic Pvt Ltd, 157 Housing Board Colony, Gulbarga 585103, Karnataka

IMPACTLINE FLOW METER

Sankyo Dengyo Co Ltd. Japan has developed Impactline Flow Meter for measuring flow rate of bulk solids and powders, e.g., pulverised substances (coal), slurries and fluids in a wide range of 0.5 kg/hr to 10,000 tons/hr and with a high accuracy of 0.5 per cent

Impactline flow meter operates on the unique principle of measuring the horizontal component of impact force, generated when the pulverised material or fluid under measurement falls freely on a sensing plate This force is proportional to the instantaneous flow rate and is not affected by material adhesion on the sensing plate. The horizontal component of impact force is converted into an electrical standard signal through transducers and microprocessors

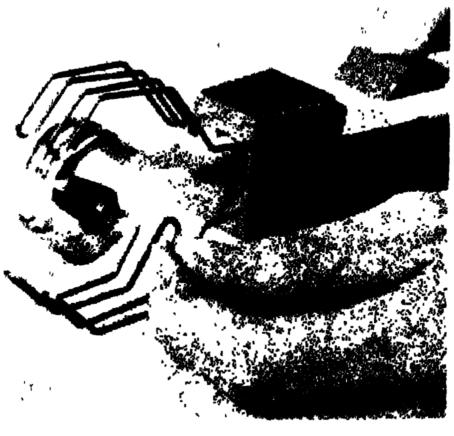


IMPACTLINE FLOW METER

Contact. Toshniwal Industries Pvt Ltd, Industrial Estate, Makhupura, Ajmer 305002.

GLO-RING HEAT TOOL

This Glo-Ring Infrared Heat Tool incorporates quartz encapsulated heating elements which open and close like a thumb and forefinger, to encircle the work piece with instant infrared heat, variable in temperature up to 1500° F The interchangeable plug-in elements are gold plated to focus heat towards the centre of the work piece The Glo-Ring is used in the electrical and electronics industry for applications requiring flameless heat, including heat shrinking, plastic tube bending, soldering, adhesive curing, solder preforms, etc



GLO-RING HEAT TOOL

With the new 1.25cm diameter elements, the infrared heat is concentrated in a small area, allowing the unit to be used on very small work pieces. The elements are available for either intermittent use in the Glo-Ring when hand-held or continuous use when the tool is used with its lock-on button, on the bench stand provided.

Contact: The Eraser Company, Inc., P.O. Box 4961/Oliva Drive, Syracuse, New York 13221.

FREE KEYBOARD DESIGNER'S KIT

Industrial Electronics Engineers Inc. (IEE), a leading manufacturer of electronic products is providing Free Designer's Kits to engineers involved in the planning and specification of custom keyboards and front panel assemblies.

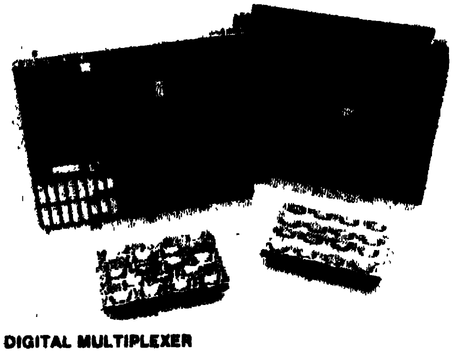
Each kit contains checklists, work sheets and a suggested reading list. A custom, plastic pickett drafting template is also included. It can be used to speed up the drawing of standard or custom keycaps in a variety of shapes and sizes, and also simplifies keycap spacing. Additional cutouts on the template can be used for standard radii and screw heads, making it useful for general drafting and sketching tasks as well.

FREE KEYBOARD DESIGNER'S KIT

Contact: Industrial Electronic Engineers Inc., 7740 Lemona Avenue, Van Nuys, CA 91405.

DIGITAL MULTIPLEXER

MDB Systems Inc. announces a Digital Multiplexer Family (DMF) of high speed expandable multiplexer systems for Unibus and VAX computers. This provides significant performance benefits over other controllers such as the DZ and DH11, due to its capability to switch between DMA and programmed I/O SILO mode.



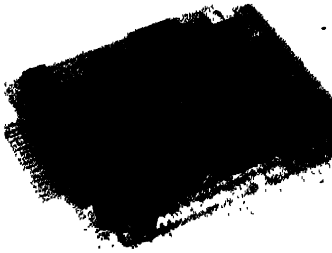
DIGITAL MULTIPLEXER

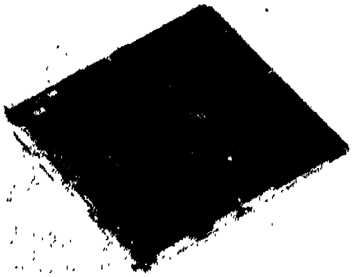
Short messages are sent direct via programmed I/O mode, and there is no DMA set-up time involved Longer messages are

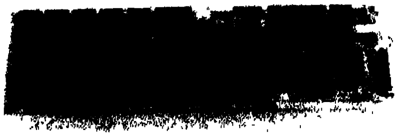
sent via DMA, not broken up as in programmed I/O mode. The total capability of up to 256 terminals is based on the utilisation of a 29116 ultra-high performance 16-bit microprocessor.
Contact: MDB Systems Inc., Corporate Headquarters, 1995N. Batavia Street, Box 5508, Orange, California 92267-0508.

IBM COMPATIBLE ADD-ON CARDS

The CPU-PC Main Board is a single computer board compatible with the IBM PC. The main board houses a 16-bit 8088 CPU with a socket for the optional 8087 maths co-processor. It has a standard 128K bytes of random access memory (RAM) and the system can be expanded to 640K bytes. It has five IBM PC compatible ports for user interface. In addition there is a fully programmable RS232C interface and a parallel port with Centronics interface
Contact: Multitech Industrial Corporation, 266 Sung Chiang Road, 9F, Taipei, Taiwan, Republic of China.


DISC DRIVE ADAPTER—FDI—PC

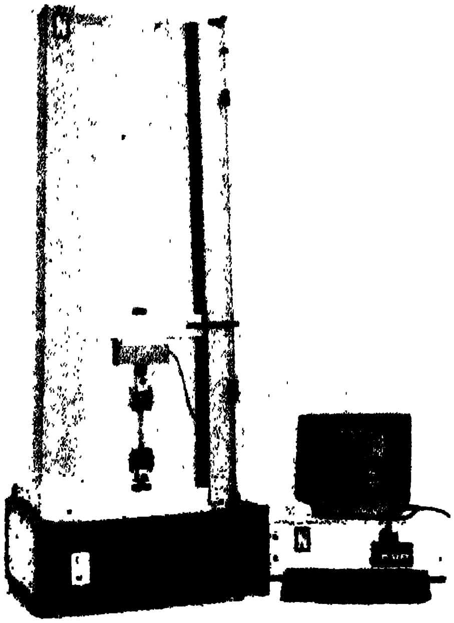

CPU-PC MAIN BOARD


MFB—PC MULTIFUNCTION BOARD

3278—PC INTERFACE CARD

COMPUTER-CONTROLLED UNIVERSAL INDUSTRIAL TESTER

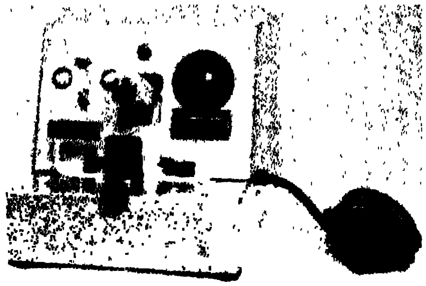
All the benefits of microcomputer control and data processing are combined with mechanical components of proven ruggedness and reliability in a universal testing machine from Britain. Incorporating a closed-loop tacho-feedback servocontroller and recirculating ballscrews, the MC3000 offers a maximum force capacity of 30 kN in either tension or compression modes, and speed is infinitely variable from 0.5 to 500 mm/min.


UNIVERSAL INDUSTRIAL TESTER

All functions are controlled from the computer which also provides full facilities for processing test data. Software is available for tensile, compression and flexure testing. Direct force and displacement data and stress and strain data can be indicated in absolute units. A graphics capability permits test data to be displayed in the form of a graph. Outputs are provided for transferring data to plotters and printers.
Contact: Nene Instruments Ltd, 21/23 Park Road, Wellingborough, England NN8 4PW.

BLUE ARC STRIPPER

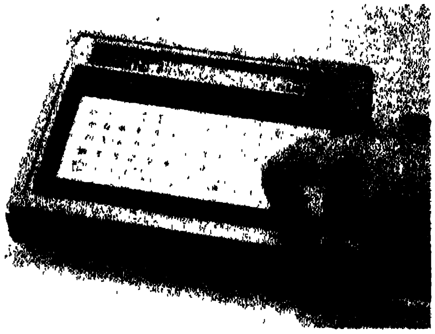
The MSS-205 Blue Arc Coaxial Braid Stripper cleanly severs the braid of shielded wires at a predetermined point, and fuses the individual strands of the braid together to prevent fraying.


BLUE ARC STRIPPER

To strip a braid, the wire end with the braid exposed is placed in the bottom electrode, and the 5-position power selector switch is set to the level desired to control the degree of severing. When the footswitch is pressed, the electropneumatic controls automatically complete the stripping by use of high current, low voltage AC electricity. The MSS-205 measures 25 cm × 40.25 cm × 25 cm and weighs 75 lbs, operates from a 220/240V, 50/60Hz power supply, and requires a 90 PSI air supply.
Contact Rush Wire Strippers, P O. Box 4961, Townline Road, Syracuse, New York 13221.

MINI-TERMINAL

A touch-sensitive keyboard and an LCD window are the external trademarks of a mini-terminal presented by Siemens for the microcomputer systems. It is virtually as powerful as a conventional terminal with VDU and desk-top keyboard. CMOS devices are the mini-terminal's internal trademark 80C31 microcomputer, EPROM (up to 8 kB) and RAM (up to 16 kB) The unit allows program sections to be transferred from the development lab to the place of application or amended there. The mini-terminal can be battery-operated for up to 8 hours. A second battery backs up the CMOS RAM.
Contact: Siemens AG, Zentralstelle für Information, Postfach 103 D-8000 Munchen 1 Federal Republic of Germany.


MINI TERMINAL

COMPONENT LEAD FORMER

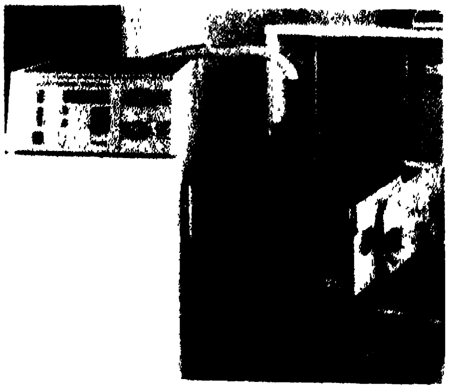
The Model Arm-1 component head Former is a compact, bench-mounted, hand-operated unit desighed to cut and bend at 90°, axial components up to 2 watts. The unit is robustly

COMPONENT LEAD FORMER

constructed to handle larger component leads with ease The sequential method of cutting and forming prevents axial torsion and mechanical stress on the component body and leads The adjustable forming dies permit underbending on components to produce a lock-in configuration if desired
Contact Wybar Electronics P O Box 4961, Vincent Drive, Syracuse, New York 13221

PRECISION TEMPERATURE FORCING SYSTEM

To meet the demanding requirements of computer controlled test facilities, Thermonics introduces the Precision Temperature Forcing System This versatile test system provides the test engineer with the capability of testing components such as integrated circuits, hybrids and discrete devices at the temperature extremes of -70° C to +200° C directly on the autotester performance board



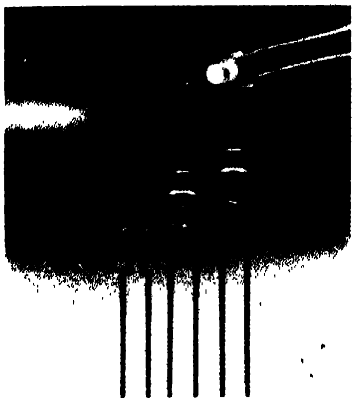
PRECISION TEMPERATURE FORCING SYSTEM

This is a single stage mechanical refrigeration system (no LN2 or CO2 required) with microprocessor based control system and thermal fixture, and is housed in a roll around chassis. This system heats/cools devices by forcing a stream of temperature controlled air over the device to be tested
Contact: Hindco Corporation, 'Shiv-E-Numh', 205-A, Dr Annie Besant Road, Worlinaka, Bombay 400018

FIBREOPTIC RECEIVER

Hewlett-Packard Company's Fibreoptic Receiver operates at speeds up to 150 MHz with low noise and high responsivity This serves as a low-priced alternative to metallic link for many applications in communications equipment, computers and other markets Low noise and high responsivity improve its performance The current which passes through the photodiode when no light is shining on it, mesures a low 300 pA at 20 volts reverse bias This lowers the noise level of the entire receiver

The low capacitance, 1.6 pF, improves the noise performance of the user's preamplifier circuit



FIBRE OPTIC RECEIVER

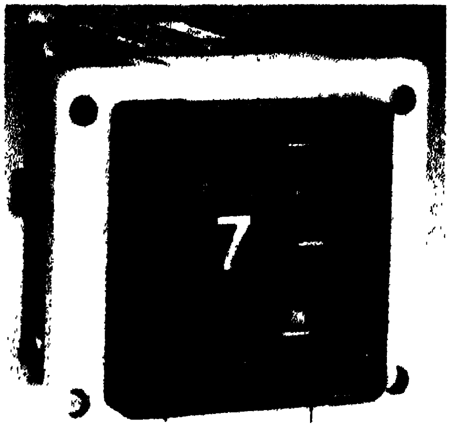
Hewlett Pakard has also integrated several microwave components previously used in counter manufacture onto a single hybrid GaAs circuit This has yielded two microwave-frequency counters the HP 5350A and 5351A. The counters measure 20 GHz and 26 5 GHz, respectively, with resolution better than 1 Hz. The counters' sensitivity is rated at -25 dBm at 500 Hz to 12 4 GHz, -20 dBm at 12.4 to 20 GHz, and -15 dBm at 20 to 26 5 GHz The high sensitivity permits the counters to be used in applications where very low signal levels are present

The Company's new microwave scalar network analyser, the HP 8757A, incorporates operating and performance features to increase user productivity in traditional measurements of microwave components as well as in other applications

The HP 8757A analyser, combined with a swept-frequency signal source, microwave bridge and detectors, measures transmission and return loss from 10 MHz to 26 5 GHz in coax and to 40 GHz in waveguide (with provisions for still higher frequencies).
Contact. Blue Star Limited, Band Box House, Prabhadevi, Bombay 400025.

THUMBWHEEL SWITCH

This 7000 series Thumbwheel Switch offers, in addition to its shielding properties, a completely sealed contact area that is impervious to salt spray, dust and high humidity. The corrosion-resistant unit can be used safely in combustible or explosive environments and in ambient temperature ranges from -65° to +85° centigrade. Illumination lamps are replaceable without tools or soldering and provide illumination without glare in low ambient light. The 7000 series is available with PCB or cable termination.



THUMBWHEEL SWITCH

Altitude rated to 21,335 metres the lightweight switch (approximately 0 40 ounce) is ideal for aircraft or shipboard applications, or wherever rugged, military-grade quality is called for
Contact. EECO Limited, Trafalgar Way, Bar Hill, Cambridge. CB38SQ England.

CONNECTORS

Alpha Wire Corporation, USA manufactures twist-on BNC and TNC coaxial cable connectors These connectors have one piece construction and provide an easy, dependable means of terminating coaxial cables. There are no loose parts in the connectors Rated at 40 lbs they have a good tensile strength when properly installed No soldering or heating which could damage the connection, self centering design allowing the centre conductor to easily enter the contact mechanism, centre contact eliminating vibration or corrosion interference, damage or loss are some of the special features.
Contact: Krishna Agencies & Services Company, P O Box No. 4106, Jayanagar, Bangalore 560041.

CRT MEASUREMENT PHOTOMETERS

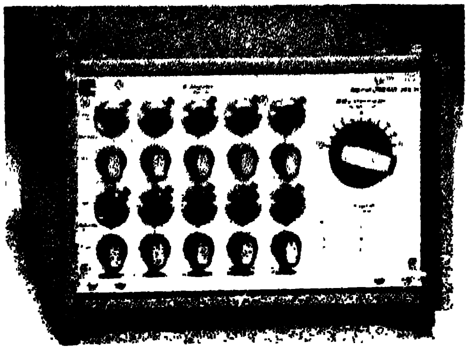
United Detector Technology has launched two more CRT Measurement Photometers. The first model is designed for laboratory applications. The standard system employs a photometric detector/filter head in conjunction with special optics to achieve a 15° field-of-view. In addition, an optional reflex viewing module accommodates a variety of lenses that allow the instrument to measure areas down to a single pixel, or up to partial or full screen. To insure accurate and meaningful luminance measurements, spectral response is matched to the human eye, and electronic bandwidth is designed to correctly average the raster scan of CRTs.

The second model is designed for manufacturing and inspection use. It is a self-contained hand-held instrument that measures full-screen brightness. Featuring low cost and a compact, rugged design, it is expected to find wide use by quality assurance personnel on CRT production lines.
Contact: Toshni-Tek International, 267 Kilpauk Garden Road, Madras 600010.

MEASURING POINT SELECTOR UNIT

The Manual Measuring Point Selector Unit UMG10 from Hottinger Baldwin Messtechnik GmbH, West Germany permits the simultaneous connection of ten measuring points to any measuring amplifier Individual zero balancing can be carried out for each measuring point

The UMG10 is very easy to operate, and any strain guage bridge configuration and inductive transducer can be connected. As the unit does no require a power supply, it lends itself to mobile use

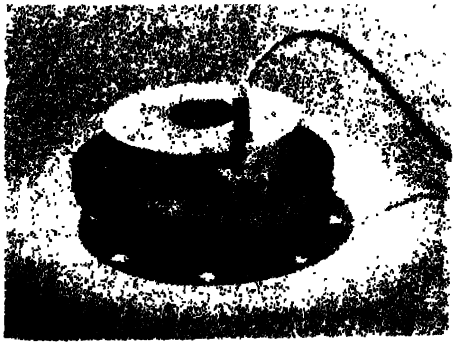


MANUAL MEASURING POINT SELECTOR UHG 10

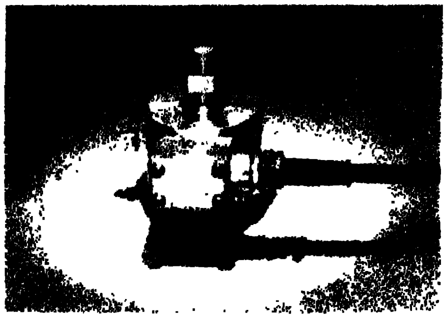
Problem pressure measurements in viscous and highly viscous media are eliminated by the Absolute Pressure Transducers. The transducers, which are suitable for measurements in gases and liquids, consist of corrosion-resistant steel and can be overloaded to ten times their nominal pressure without damage The measuring elements are equipped with metallic strain gauges using the latest thin film technology, and possess good zero signal stability Temperature effects between -40°C and +100°C are compensated

ABSOLUTE PRESSURE TRANSDUCER

The Force Transducer Z12, a new design is distinguishable from conventional mounting flange and its inner bore allows easy installation in testing machines where loading can be both compressive and tensile. It has the extremely good accuracy class of 0.03.

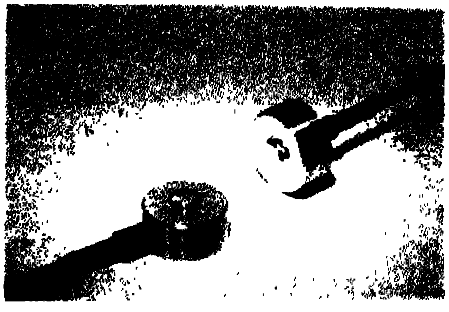


FORCE TRANSDUCER Z12



FORCE TRANSDUCER U2A

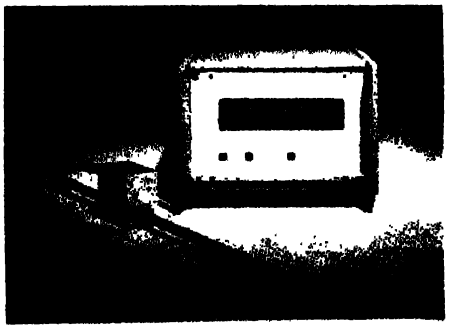
New Compressive Force Transducers type C9 and C90 made of corrosion-resistant steel and are small and sturdy They are available for nominal values of 10 kN and 20 kN Because of their small dimensions, these transducers can easily be incorporated into existing equipment These new force transducers use the latest strain gauge technology and are to accuracy class 1



FORCE TRANSDUCER C9 & C90

The new Inductive Displacement Measuring System developed by the company detects displacements of upto 1 9 m with a resolution of 10µm Speeds of upto 15 m/s can be dealt with, permitting measurement even on rapidly moving objects The displacement is detected by means of a transducer The system recognises the directions of movement and can add or subtract displacement to or from the display with the correct sign This new system has the added advantage of being unaffected by dust and dirt.

Contact. Integrated Process Systems, 278, III Floor, Khaleel Shirazi Estates, Pantheon Road, Madras 600008



NEW DISPLACEMENT MEASURING SYSTEM

INTEGRATED A/D CONVERTER

Utilising CMOS technology, this family of Dual slope Integrating A/Ds introduced by Maxim features excellent differential linearity, high NMR of power line frequencies, virtually no zero offset, 5 PPM/°C and maximum gain temperature coefficient All these incorporate a 'zero integrator' phase to ensure fast recovery from over range inputs Maxim has increased ESD protection to greater than 2kV on each pin, thus reducing field failure rates.

Contact Malhar Corporation, 43, Wheeler Road, Cox Town, Bangalore 560004

INTEGRATED A/D CONVERTER

ACCELEROMETERS

Accelerometers manufactured by ACD Machine Control Company are piezoelectric type They are polarised and exhibit definite electrical properties essential for detecting vibrations, seismic movement, high frequency noise, etc Totally stainless steel construction consists of piezoelectric discs mounted on studs and a total casing which acts as a mass Its sensitivity is atleast three times more than any conventional moving mass piezoelectric accelerometers

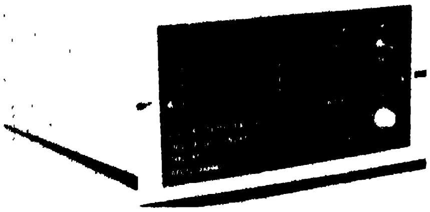
ACCELEROMETERS

The output is directly taken out and terminated on UHF male connector without use of any adhesives. Therefore, long term consistency is achieved The cable length is normally one metre This accelerometer is rugged and immune to any electromagnetic forces such as high intesity 50 Hz field

Contact: ACD Machine Control Company (P) Ltd, E-6, Udyog Sadan No. II, MIDC Andheri (E), Bombay 400093.

TEMPERATURE INDICATOR

Temperature Indicator Digitally Linearised (type DTI-I an accurate and dependable instrument measuring temperature from 0 to 1700°



TEMPERATURE INDICATOR

Linearisation is based on data stored in EPROMs. Each point of the thermocouple is stored in the memory. Instrumentation grade amplifier gives excellent linearity, low drift and high input impedance. Automatic line resistance and cold junction compensation are incorporated. Individual LEDs are provided for open thermocouple, reverse thermocouple and over-range indication.
Contact: Analog & Digital Instrumentation, 962, GIDC Makarpura, Baroda 390010

INK CARTRIDGE

The latest Ink Cartridge developed by Arora Enterprises is suitable for Kents recorder. 'Suvichem' slow drying precision recording inks filled in these cartridges and ink-filled cartridge are supplied with red, green, blue, black, violet, orange and yellow colour inks.

INK CARTRIDGE

The cartridges are made from best quality, high density polythene.
Contact: Arora Enterprises, 301, Sheth Chamber, Marimata Lane, Rajmahal Road, Vadodara 390001

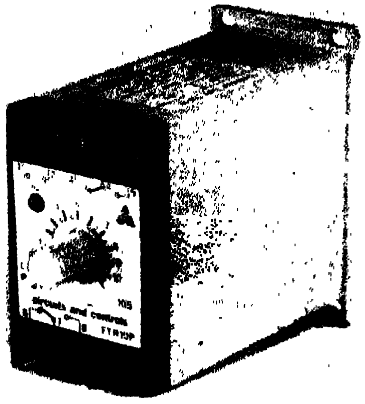
DIGITAL PORTABLE KIT

Century's digital water analyser kit called Digital Portable Kit has been designed for the on-the-spot study of parameters such as pH, conductivity, redox potential, temperature and dissolved oxygen. Housed in fibreglass brief-case, this is a true portable kit most suitable for pollution control and environmental studies. The kit has LCD display with both battery and mains operation. Single 9V battery operation, reduced battery consumption, automatic low battery indication are its other features.
Contact: Century Instruments Pvt Ltd, S.C.O. 289, Sector 35-D, Chandigarh 160036.

DIGITAL PORTABLE KIT

ELECTRONIC TIME RELAY

Electronic Time Relay ETR ID is a solidstate ON delay timer that operates with high repeat accuracy between wide ranges of voltage, frequency and temperature. The timer uses a RC bridge type timing circuit, nullifying the effect of voltage variation and a trigger circuit that switches an electromagnetic relay giving smart and positive operation. Use of glass-epoxy PCB eliminates the chances of leakages or breakdown. The power supply is indicated by a green LED marked 'V' (voltage).



ELECTRONIC TIME RELAY

The timer comes in a moulded plastic casing and the terminals are designed in slots so that the line parts are not easily touchable.

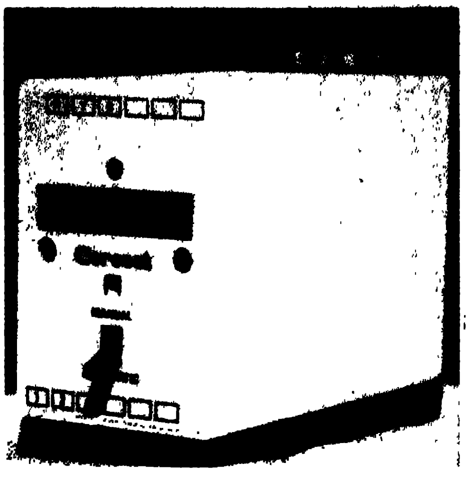
The timer is available for 110/220V AC supply voltages at 50 to 60 Hz. Permissible ambient temperature limit is between -15°C to +55°C and voltage limit is between 80 to 110 per cent of rated voltage. It consumes about 6 5A with contact rating of 5A.
Contact: Circuits and Controls, 12/4, Bhattacharya Para Lane, Calcutta 700036.

AUTOMATIC MOTOR CONTROL RELAY

The Coronet Automatic Motor Control Relay is a must for motors which are run by maintained contact devices such as, floatswitch, pressure switch, thermostat switch, etc, so as to prevent starting of the motors on 2-phases.

It starts the motor as soon as the power supply resumes. No attendant is required to switch on the starter button. It stops the motor in case of phase failure, phase reversal, low voltage and high voltage. The motor is automatically started when the missing phase supply resumes or the voltage comes within the operating range.

Built-in trip time delay avoids nuisance trippings caused by momentary line voltage fluctuations. Fail-safe design allows it to pick-up only under healthy conditions of power supply and drop off if there is any fault or an open circuit. It protects the motor under all conditions of load, even under no-load conditions. Its indicating lamp glows only when the power supply is normal and phase sequence is alright. The HP rating of the motor is immaterial since this device is not current dependent. A bypass switch (toggle switch) is provided in the device which enables the user to run the motor manually from the motor starter as usual.
Contact: Coronet Control Devices, Deonghat, Golan 173211 H.P.



AUTOMATIC MOTOR CONTROL RELAY

CARGARD-DELUXE

Bhatts Electronics has introduced a Cargard Deluxe alarm system which is easy to instal. It neither interferes with the existing car wiring nor requires any extra wiring to activate the alarm. This model has a built-in adjustable time delay which allows the entry time delay to be varied from 5 to 15 seconds, in order to accommodate a longer or shorter entry time for owners to enter the vehicle and switch off the alarm before the alarm actually starts. The Cargard has a sensor which needs to be clamped to the main electrical lead of the car.
Contact: Elsonic Santo Corporation, 8/1, Palmgrove Road, Bangalore-560047.

CARGARD-DELUXE

DIELECTRIC COATING

ESL's new cermet Dielectric Coating, 4905-C, resists substrate warping even with many layers and refirings. Because the temperature

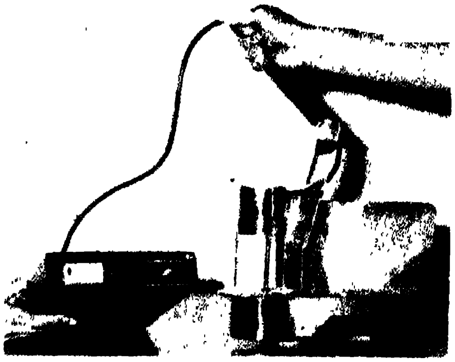
DIELECTRIC COATING

coefficient of expansion (TCE) this model is carefully matched to the TCE of the alumina substrate In recent user evaluations 4905-C was successfully used to produce a conductor layer multilayer (24 separate dielectric prints) with no harmfull bowing of the 10cm × 15 cm alumina substrate. The high density of this non-porous multilayer dielectric permits the use of economical palladium-silver 'buried' layers with a gold top layer without blistering or shorting

Contact: Eltecks Corporation, C-314 Industrial Estate, Peenya, Bangalore 560058

DIGITAL WATER CURRENT METER

This Water Current Meter can be used for measurements in fresh water as well as saline sea water directly. The underwater current sensing probe has got streamlined design features and aligns with water flow keeping the rotor always in vertical axis despite the tilting of the suspension rope. The electric pulses produced proportional to the rotation of the rotor are processed and displayed in the digital meter directly in the range of 0 to 400 cms/sec The compact meter is operated on self-contained 9V dry cells with current consumption less than 50 mA The meter with hydro-dynamic design features needs comparatively very low fish weight enabling easy and convenient operation.



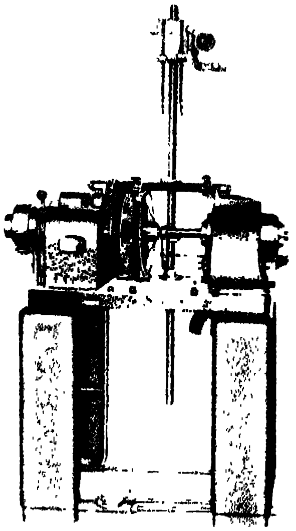
DIGITAL WATER CURRENT METER

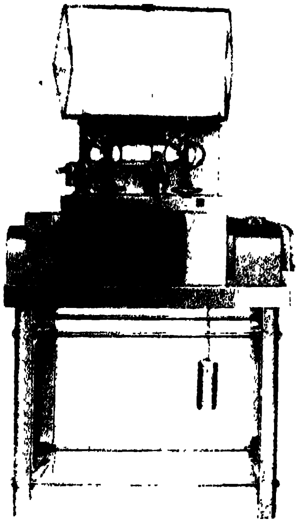
Contact: Environmental System Engineers, Kadavanthra Road, Cochin 20.

TV DEFLECTION COIL WINDING MACHINES

These are equipped either with double spindle mechanical and electrical controls or electrical, pnuematic and mechanical controls. The main motor runs on 440V AC, but the entire circuit runs on 24V DC. These are available in two models, one suitable for horizontal coils and other for vertical coils of TV deflection yokes.

Model GS-TVP is equipped with electrical, pnuematic and mechanical controls.





TV DEFLECTION COIL WINDING MACHINES

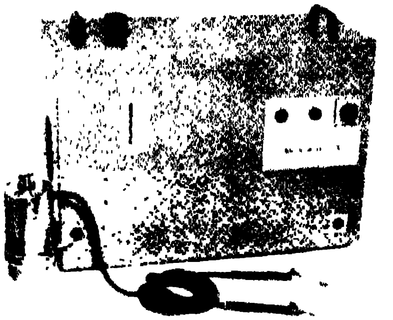
Mechanical clutch, solinoid airvalves, magnets and electrical timer are used in this machine to make the operation more efficient with maximum automation This machine is suitable for horizontal coils of TV deflection yoke.

Model GS-TVL is equipped with double spindle, mechanical and electrical controls and clubbed by electromagnetic clutch, solenoid magnets etc. The machine is suitable for vertical coils of TV deflection yoke.

Contact: Gahir Industries (Regd), 2816 Street-1, Jammu Colony, Opp. Atam Park, Ludhiana 141003.

MICRO BRAZER

Micro Brazer is a unique machine for multipurpose brazing/soldering of small parts with pin-point application. It generates its own fuel, i e., a mixture of hydrogen and oxygen gases, consuming inexpensive distilled water by the electrolysis process. It has its unique built-in safety devices to keep the pressure of this mixture at a controlled low pressure.



MICRO BRAZER

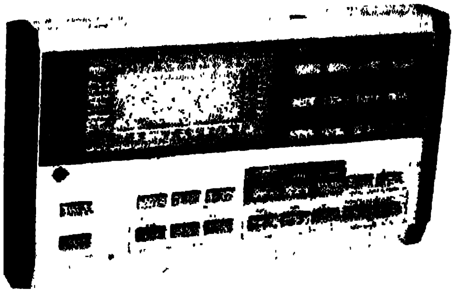
The self-generated hydrogen-oxygen mixture is passed through a gas atomiser containing appropriate solution (i e methylated spirit, MEK, acetone, depending on the flame temperature required) and discharged through a micro torch with fine flame regulation, to give a very fine controlled and cleaner high temperature flame

Contact Harshda Engineering & Electric Co., 49, Laxmi Insurance Building, Sir P.M. Road, Bombay 400001

LOGIC ANALYSER

The Logic Analyser HIL 2010 gives a new dimension to the use of logic analysis in field troubleshooting Weighing merely a kilogram and with unprecedented system packaging (253W × 140D × 38H,mm)

It has 16 channels, operating both in synchronous and asynchronous modes The state analysis offers powerful features like search, compare (with a separate reference memory having same depth as the acquisition memory) and a choice of display formats The timing analysis also is equally powerful with glitch capturing facility, expand mode etc. This hand-held logic analyser also offers a flexible triggering system with pre, post, centre trigger; with trigger and clock delays. A window display presents a comprehensive map of the acquisition memory highlighting, among others, the trigger point and the displayed data location. A histogram display is another special feature. It displays a ratio of high bits to low bits in each channel

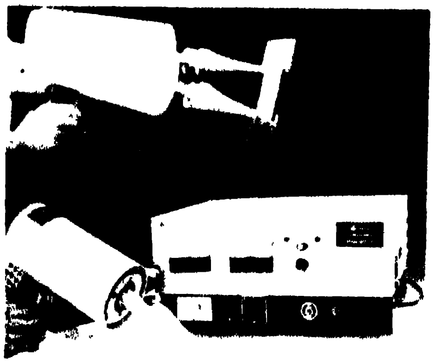


LOGIC ANALYSER

Contact: Hindustan Instruments Limited, 603 Vishal Bhawan, 95 Nehru Place, New Delhi 110019.

ULTRASONIC PLASTIC WELDER

It is a compact, lightweight ultrasonic hand-



ULTRASONIC PLASTIC WELDER

held plastic welder designed specifically for rapid spot welding of thermoplastics. It consists of a generator, welding head fitted with transducer, pistol grip handle and welding tool. It can spot-weld thousands of spots at the rate of one weld per two to four seconds. Clean and fast welding is possible by localised ultrasonic vibratory heating and molecular flow. No messy chemicals are required and cost of chemicals is also eliminated. It is ideally designed for welding assemblies that cannot be positioned under a welding head, and is also good for hard-to-reach joint areas. Hermetic dust proof and clean seals are possible.

Contact Imeco Ultrasonics, Post Bag No 16643, Matunga, Bombay 400019

SOLIDSTATE CONTROLLER

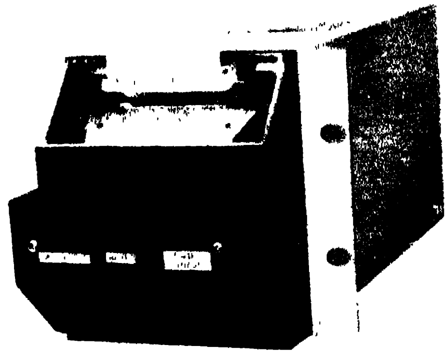
The Solidstate Controller (Dimmer) is developed with radio frequency suppressor with linear motion. It is useful for controlling the power of light, fan, iron, oven, sewing machine, stirrer etc. The circuit is mounted in acrylic body of 6.25 cm × 8.75 cm × 3.22 cm. The circuit is also available mounted on PCB without cabinet which can be used in table-lamp or any other accessories.

SOLIDSTATE CONTROLLER

Contact. Electronics Hobby Centre, F-37 Nand Dham Industrial Estate, Marol, Bombay 400059.

NUMERIC PRINTER

The Numeric Printer uses rugged and reliable EPSON print mechanism 460. It is housed in most compact quarter size of 47.5 cm sub-rack which can be mounted into a panel as well as used separately on a table. The printer is designed with a draw-put mechanism whereby it is not necessary to disturb the panel mounting whenever the paper roll has to be replenished. The front panel features are simple and kept to a minimum, namely, print push button and paper feed pushbutton. The back panel contains standard D sub-connector to accept the various data lines. The printer can accept parallel data as well as multiplexed data. A separate input line is provided for colour change. When this line becomes active, the printer prints the line in red colour.



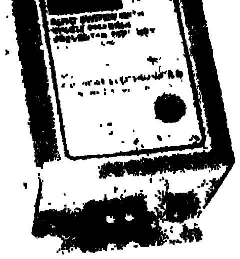
NUMERIC PRINTER

Contact: Arun Electronics Pvt Limited, B/125-126, Ansa Industrial Estate, Saki Vihar Road, Bombay 400072.

AUTOMATIC SINGLE PHASING PREVENTER

The single phasing preventer is a voltage filter where negative sequence voltage is sensed and used to trip the motor starter. It uses ICs to protect 3-phase AC motor against single phasing, unbalanced supply, and too high, too low voltage. In case of wrong phase sequence the motor automatically gets switched off within three seconds, thus preventing motor from being burnt. After getting normal voltage it automatically switches on the motor. No manual operation is needed. Suitable for all HP motors.

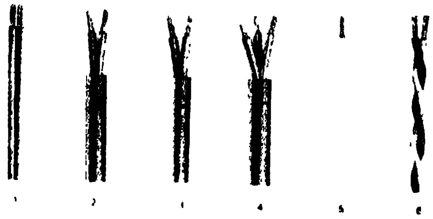
Contact. M.R.K. & Brothers Engineers, 310 A, Commerce House, Nagindas Master Road, Fort, Bombay 400023



AUTOMATIC SINGLE PHASING PREVENTER

FLEXIBLE CABLES & CORDS

The cable on hand-operated Power Tools and appliances needs to be highly flexible and resistant to abrasion, mechanical stresses and extremes of temperature. The Novoflex Flexible Cable is specially designed for this purpose. Special PVC compounds are used for these cables for extra flexibility, resistance to water, oil, acids, alkalies, grease and sunlight and if ignited they arrest the spread of fire. These cords have good ageing properties, are light in weight, smooth, glossy, unkinkable easy to handle and to clean. Clear colour coding of the insulation is possible and colours penetrate the entire insulation.



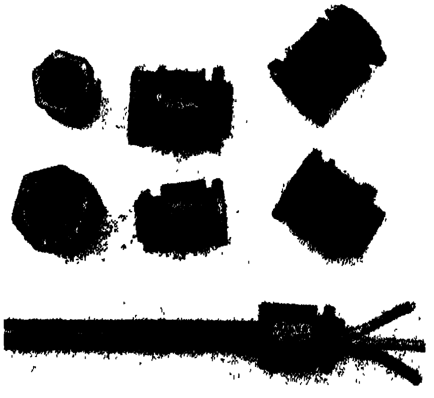
FLEXIBLE CABLES & CORDS

These cords are particularly suitable for application in very wide range of house hold-industrial appliances. These cables are ISI marked.

Contact: Novoflex Cable Industries, Block A-14, 7th Floor, Chatterjee International Centre, 33A, Chowringhee Road, Calcutta 700071.

POWER CORD CONNECTOR

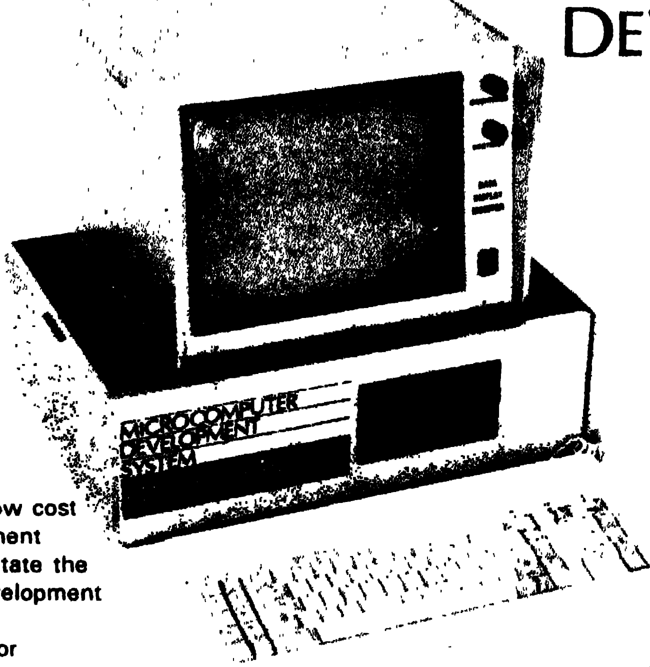
This unique new Power Cord Connector outperforms traditional connectors. In one single operation, by merely inserting the cord or cable through the centre hold and screwing down the sealing nut, the cable is held in position, centred, waterproofed, strain relieved and automatically adjusted to the size of the cable. This connector is available in black colour and is resistant to salt water, weak acids, weak alkalies, alcohol, ester, keytones, ether, benzine, gas, mineral oil, animal and vegitable oils and can withstand temperature extremes of -35°C to +115°C.



POWER CORD CONNECTOR

Contact: Novoflex Cable Care Systems, Post Box No. 9159, Calcutta 700016.

COST EFFECTIVE WAY TO MICROCOMPUTER DEVELOPMENT



MICROCOMPUTER DEVELOPMENT SYSTEM

PROFESSIONAL-1

PROFESSIONAL-1 is a low cost Microcomputer Development System designed to facilitate the complete task of the development of the hardware and the software of microprocessor based products. Specifically PROFESSIONAL-1 helps the user in the following tasks.

1. Development of Target Software :

The software for the target system can be developed on PROFESSIONAL-1 in assembly/high level language thus greatly increasing the programmer productivity. The source programme is stored on mini-floppies and can be easily edited, assembled and listed on the printer. I/O independent routines of the user software can be easily debugged on PROFESSIONAL-1 itself using symbolic debugger.

2. Testing of Target Hardware :

PROFESSIONAL-1 provides a convenient method of testing the user fabricated hardware using the In Circuit Emulator for the particular microprocessor used in the target hardware. Now the entire target hardware can be controlled from PROFESSIONAL-1 through the I.C.E.. The user may exercise the Address/Data/Control bus, calculate ROM sum check and test RAM blocks of the target system from PROFESSIONAL-1. User may also enter diagnostic routines in the memory of the target system and trace their execution or run them at full clock speed to test various sections of the target hardware systematically.

3. Transfer of Assembled Programs to a Prom Programmer

PROFESSIONAL-1 provides RS 232 C serial data link for transfer of data between PROFESSIONAL-1 and an external systems. This data link is used to transfer assembled user programs to PROM Programmer (for example PEP's PP-81) for programming the EPROMs to be used in the target system

4. Implementation of Software in the Target System :

Implementation of user software in the target hardware is the central problem in the development of any microprocessor based product. PROFESSIONAL-1, alongwith In Circuit Emulator facilitates this task greatly.

5. Cost Effective Solution :

Professional-1 is available indigenously at a fraction of the cost of imported Microcomputer Development Systems and you don't have to wait till eternity for delivery and service.

For further details or a demonstration, write to :

PEP

Professional Electronic Products
[illegible] MEERUT 250002
[illegible]

DESIGN CENTRE

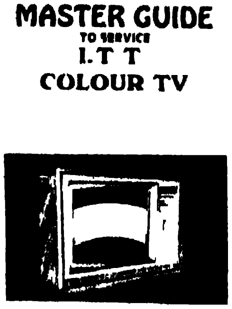
Book Reviews

The CP/M Handbook with MP/M

By Rodnay Zaks; published by BPB Publications, New Delhi, by arrangement with Sybex Inc., USA; pages 320 (15 cm × 23 cm); soft cover; price: Rs 75.

This book on CP/M and MP/M (control program/multiprogramming control program for microprocessors) is an in-depth yet objective study of computer commands Studded with easy-to-understand examples, the book is designed to catch the imagination of novices aspiring to perfect their skills Even people who are well conversant with CP/M and MP/M will find the book of considerable importance as many versions of CP/M have been defined An excellent reference guide for business users, input typists, first time computer users and experienced programmers

—Prem



Master Guide to Service ITT Colour TV

By Desai and Desai; published by Jeevandeep Prakashan, Bombay; pages 49 (18 cm × 26 cm); soft cover; price: Rs 25.

With the boom in colour TV production in India, the market has been flooded with various brands of TV sets most of them using the kits designed by ITT a West German company This master guide is a technical manual providing the details for servicing of CTV sets bearing the brand names of ECIL Keltron Dyanora Televista and Uptron—all assembled basically with the ITT kits

The book has been divided into eight chapters providing an insight into fault finding waveform analysis and voltage analysis Chapter one introduces readers to the PAL colour television system chapter two explains the block diagram of the ITT-based receiver and chapter three delineates the features of the receiver Chapter four gives the circuit description of UHF/VHF tuner AF/IF module, vertical/horizontal deflection, PAL colour decoder and SMPS power supply circuits Chapters five and six deal with voltage analysis and fault finding in the chassis while chapter seven provides the data sheet for ICs TDA 3560, TDA 1950 and TDA 1035-T used in the circuit The last chapter deals with fault finding and waveform analysis in PAL decoder using CRD In addition, the book gives the complete circuit diagram of the ITT-based receiver for the benefit of field service engineers The book envelopes the complete theory and practical aspects of servicing the ITT colour TV and will prove helpful to CTV service engineers

—D G

IBM PC Troubleshooting & Repair Guide

By Robert C. Brenner; published by BPB Publications, New Delhi, by arrangement with Howard W. Sams and Co. Inc., USA; pages 204 (21 cm × 27 cm); hard cover; price: Rs 180.

This book with a number of schematics, photos and block diagrams will help in identifying the problems easily and in keeping the IBM PC in top operating gear The simple instructions tell the reader how to fix his personal computer quickly and the easy-to-understand circuit diagrams enable him to make most repairs with few or no tools, quickly zero in on the malfunctioning components and reduce downtime, amounting to considerable repair saving The concepts are explained in clear and precise style so as to make electronic trouble-shooting both interesting and rewarding This fully illustrated book is recommended for any one having an IBM PC

—B V R

Directory of Indian HAMS, 1985

Published by the Federation of Amateur Radio Societies of India, Madras; pages 63 (18 cm × 24 cm); soft cover; price: Rs 10.

This special Indian callbook issue of the federation is a directory of licensed radio amateurs in India. This new edition has been updated till August 1985 the earlier edition having been published in 1982. The book contains over 2100 entries and will be found useful by all amateurs (HAMs) and shortwave listeners (SWLs).

—B.V.R.

Company Profiles

DCM Data Products to expand

DCM Data Products, a division of DCM Ltd, is planning to manufacture electronic teleprinters, dot matrix and daisy wheel printers. Negotiations for technical collaboration with Oki of Japan are in an advanced stage. The company is also developing printed circuit boards for electronic PABXs in cooperation with the Centre for Development of Telematics (CDOT).

The company is introducing two new computers incorporating the latest technology. The Olympic minicomputer based on Intel chip and supported by Xenix software will be marketed commercially in the next two or three months. This will cater for the demand for powerful on-line database oriented systems. The DCM Tandy 1000 colour microcomputer, one of the largest selling models in the world, will offer all features of the IBM-PC plus many more.

As a result of the expansion, the data products division is likely to achieve a turnover of Rs 250 million in the current year ending June 1986. The company has already achieved good progress in areas of energy conservation, modernisation of steel plants, improving safety on railways, ballistic testing for weapons, pollution control, blood analysis in hospitals and global communication network in banks.

ITI to issue bonds

The public sector Indian Telephone Industries (ITI) Ltd will raise Rs 1000 million by issuing one million bonds which will be exempt from wealth tax.

With this the ITI will become the first public sector undertaking to enter capital market with a bond issue. Interest on the 14 per cent secured redeemable non-convertible bonds in the denomination of Rs 1000 will be paid from the date of realisation of the cheques or drafts. Though the bonds are exempt from tax, interest earned on them will be subject to deduction under 80L of the Income Tax Act.

Both cumulative and non-cumulative bonds issued will be transferable by endorsement and delivery. The bonds will be listed on the Bombay, Delhi, Ahmedabad, Bangalore and Kanpur stock exchanges.

Out of one million bonds only half will be offered for public subscription the other half being reserved for private placement with the UTI, the LIC and the GIC.

L&T to give 12% dividend

Larsen and Toubro Ltd has registered a rise of 29 per cent in its income for the year ended September 30, 1985. Sales and other income of the company amounted to Rs 4470 million as against Rs 3460 million in the previous year. Profit before depreciation and taxation has gone up from Rs 467.6 million in 1983-84 to Rs 560.9 million in 1984-85—an increase of 20 per cent. Profit after taxation amounted to Rs 303.3 million as against Rs 232 8 million in the previous year, increase of 29 per cent. The internal generation of funds for the year was Rs 452.0 million as against Rs 356.5 million in the previous year.

As a result, the board of directors of the company has decided to recommend a final dividend of 12 per cent which together with the interim dividend declared in August 1985, amounts to a total dividend of 24 per cent—same as in the previous year. The dividend is covered more than four times by the year's earnings. The board has also recommended issue of bonus shares in the ratio of 3 equity shares for every 5 existing equity shares, subject to the approval of the Controller of Capital Issues.

Meanwhile, the expansion of the company's cement plant capacity at Awarpur to 2.2 million tonnes is progressing satisfactorily and the production is expected to commence by early 1987. The construction of shore-based heavy engineering complex at Hazira, near Surat, is also on schedule.

It has entered into collaboration with Y.E. Data, Japan for the manufacture of floppy disc drives, with Honeywell Information Systems Italia, Italy for the manufacture of dot matrix printers and with Jeumont Schneider, France for the manufacture of electronic PABX. Construction of a new factory for manufacturing these products is nearing completion in the Hebal Industrial Estate, near Mysore.

The company will also undertake the production of mobile cranes at its Kansbahal Works, Orissa in collaboration with Potain Poclain Material, France soon.

Large investment plan by Siemens India

Siemens India has finalised a massive investment of Rs 600 million for the next five years for expansion and modernisation, with a view to becoming a broad-based growth-oriented industrial electronics company.

An electronics factory, proposed to be set up at Nasik in Maharashtra, is expected to be operational in 1987-88. The company proposes to manufacture sophisticated AC and DC drive systems for boilers, chemical units and other industries.

About Rs 200 million have been earmarked for upgradation of the switch gear and another Rs 70 million for modernising the motors factory.

After nearly seven years, the company has received letters of intent for data acquisition, data logging and control systems, process control instrumentation items and protection relays.

During 1985, several new products were introduced in various fields. In the medical engineering field, the company's X-ray diagnostic equipment has been well accepted by hospitals, and agreement has been signed with Fududa of Japan for patient monitoring systems and electrocardiograph machines.

The company proposes to participate in a joint venture with a state development corporation for the manufacture of public switching systems. Discussions are in progress with West Bengal Electronics Development Corporation for manufacturing teleprinters. The cost of the project is placed at Rs 20 million.

In the current year ending September, 1986, the turnover is estimated at Rs 1700 million with a pre-tax profit of Rs 90 million.

Ankur doubles production in first year

Ankur Electronics Limited has doubled its production of plastic TV cabinets in the very first year.

Having achieved this feat, the company has now signed contracts with Weston Electroniks and Sylvania & Laxman to reach its installed capacity which will mean producing one TV cabinet every 1.5 minutes with the hot stamping and printing technology Two machines are also being acquired from Trusidma & Textima of Europe to attain good quality and precision in moulded plastics

There has been an overrun in the project cost by Rs 1 5 million To meet the cost overrun and outlay on expansion plans, the company is making a rights issue of Rs 6 million The company hopes to achieve a turnover of Rs 30 million in 1986 and Rs 60 million in 1987, and is hopeful of declaring a maiden dividend for 1986 itself

Meanwhile, it has signed a memorandum of understanding with Technicom GmbH, West Germany, along with a non-resident Indian, Mr Ashok Chauhan, chairman of AKC group, for setting up a Rs 150 million sophisticated toolroom project

ESPL's microchip project

The Electronics Systems Punjab Ltd, (ESPL), a subsidiary of the Punjab State Industrial Development Corporation, has launched its data acquisition and control system (DAS) project at Mohali in SAS Nagar Mr Surjit Singh Barnala, chief minister of Punjab, inaugurated the project on January 3

The project, in which up-to-date technology will be used, has collaboration with the Westinghouse Electric Corporation, USA

Set up five years ago, the plant has established strong R&D production, quality control and testing facilities

The range of production of the ESPL is micro and mini computers, data acquisition and control systems and agro dairy instruments This unit has been approved and has received orders from the Reserve Bank of India, the Union Education Ministry several universities, engineering colleges and many commercial banks

Ruchika Electronics poised for big leap

Ruchika Electronics Ltd, a major manufacturer of state-of-the-art electronic products for home and industry in India and abroad, is undertaking an ambitious diversification programme and is likely to enter the capital market this year to [illegible] the funds in part.

Already engaged in marketing battery-operated toys in India, the company is spreading its tentacles for making the world's latest electronic toys. The company is already licensed to manufacture black-and-white TV receiver sets (100,000 nos) and colour TV sets (50,000 nos)

A foreign collaborator has already been identified and Ruchika is negotiating with the company for a 100 per cent buy-back arrangement to increase its profitability

Keeping the future expansions in view, the company has applied for industrial licence to manufacture electronic toys, radio cassette recorders, VCRs and VCPs (in all 200,000 pieces per annum). This ambitious profile of the company is backed by a good financial base, livewire R&D source and an extensive sales network throughout the country.

PDDL's colour picture tube project

The foundation stone for the country's first colour picture tube project was laid by Mr Surjit Singh Barnala, Punjab's chief minister, on January 13.

A joint venture by the Punjab Display Divices Limited (PDDL), a subsidiary of the Punjab State Industrial Development Corporation, and the Jagatjit Cotton and Textile Mills (JCT) Ltd, the plant is to be set up at Mohali, in SAS Nagar. The colour picture tubes, so far being imported, will now be made here—thus accounting for a respectable foreign exchange saving besides helping in bringing down the CTV prices.

The plant, complete with robots, is expected to be commissioned in 18 months' time. The Rs 750 million project will manufacture half-a-million colour picture tubes every year in technical collaboration with Hitachi of Japan—the world leaders in CTV technology.

PDDL will start with a 51cm tube, with inline gun specially characterised to improve focus. The tube will be coated with black matrix strip screen using green, blue and red phosphor pigment to improve the brightness and contrast. The tube is coated using a special technique to limit the flashover currents.

The deflection yoke mounted in the tube has a very low power consumption. It does not require any pin cushion correction. Progressively the company proposes to manufacture mini-neck and super mini-neck tubes. Improvements in glass bulb in aspect ratio and a square tube with flatter screen would also be introduced progressively.

Mahendra's tie-up with Austrian firm

Mahendra Electronics has concluded a contract with Futurit of Austria, for manufacture of traffic equipment worth Rs 100 million The contract was signed at Pragati Maidan by Mr Philippe S. Pezet, export manager, Futurit and Mr Balram K. Mahendra, president, Mahendra Electronics

Futurit has introduced the application of microprocessor technology in traffic controlling, railway signalling etc. It is also a world market leader in the supply of unbreakable polycarbonate traffic lights. Thus, traffic control is expected to take a quantum leap in India with the indigenous manufacture of computerised traffic controllers based on Futurit's technology.

The CRRI and the Delhi Traffic Police have given permission to instal Futurit's equipment at an intersection in Delhi. A study of the benefits of microprocessor technology in improving traffic flow, reducing accidents, reducing fuel consumption by increasing duration of the green light is being undertaken by CRRI.

A new design of double lens unbreakable polycarbonate which increases signal visibility tremendously, even under unfavourable weather conditions, is being engineered by Futurit for use in high-speed railway track systems

Superphone India to make EPBAX

Superphone India Pvt Ltd, a premier telephone exchanges and intercoms manufacturing company, is setting up a Rs 50 million project near Bombay to manufacture electronic private branch exchanges (EPBAX).

For this purpose, the company is collaborating with Oki Electronics of Japan. The company has planned to enter the capital market in the middle of this year to raise part of the 50,000 lines capacity project cost. It is likely to issue shares worth Rs 15 million for the purpose.

Production is expected to start by the end of the year with an initial production capacity of 10,000 lines and attain the rated capacity of 50,000 lines by the end of the third or fourth year.

Superphone India is one of the 12 firms that have received letters of intent for the manufacture of EPBAX. The company has considerable experience in the analogue PABX systems and has installed 50 such systems all over the country.

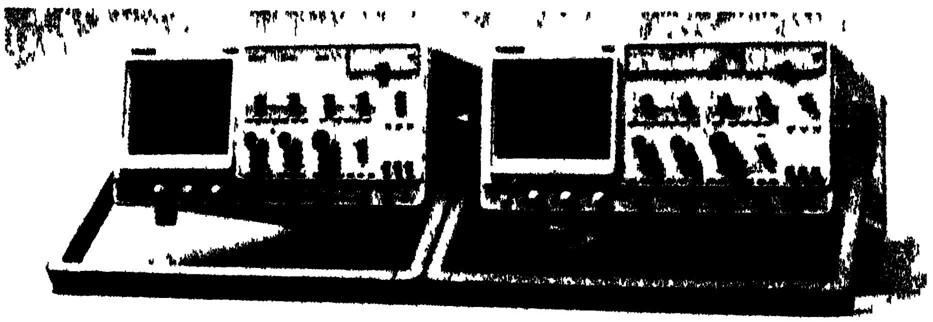
KIKUSUI

COM 7000 SERIES, WITH GP-IB PROGRAMMABILITY

Fully Programmable
CRT Readout

High Speed Digital Storage
60-200MHz Bandwidth

GP-IB



DIGITAL OSCILLOSCOPE COM 7201
Sensitivity 5mV/DIV, DC-200MHz
Max. Sweep Time 1 ns/DIV, 4 Channel
Display with 200MHz Bandwidth
Maximum Sampling Rate 50MHz,
Effective Storage Frequency 20MHz,
Single Shot 100MHz Repetitive
GP-IB Programmable
CRT Readout
DVM (AC, DC, P-P Voltage)
Frequency Counter

CRT READOUT OSCILLOSCOPE COM 7200
Sensitivity 5mV/DIV, DC-200MHz
Max. Sweep Time 1 ns/DIV, 4 Channel
Display with 200MHz Bandwidth
CRT Readout
DVM (AC, DC, P-P Voltage)
Frequency Counter

CRT READOUT OSCILLOSCOPE COM 7100
Sensitivity 5mV/DIV, DC-100MHz
Max Sweep Time 2 ns/DIV, 4 Channel
Display with 100MHz Bandwidth
CRT Readout
DVM (AC, DC, P-P Voltage)
Frequency Counter

CRT READOUT OSCILLOSCOPE COM 7060
Sensitivity 5mV/DIV, DC-60MHz
Max Sweep Time 5ns/DIV, 4 Channel
Display with 60MHz Bandwidth
CRT Readout
DVM (AC, DC, P-P Voltage)
Frequency Counter

KIKUSUI
KIKUSUI ELECTRONICS CORPN , JAPAN

Indian Agent

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Bangalore-560047

Jaikishan [illegible] Library

Facts & Figures

LICENCES AND LETTERS OF INTENT

The following licences and letters of intent were issued to electronics firms under the Industries (Development & Regulation) Act, 1951 during the months of August and September 1985.

Name & Address of the Applicant and location of the undertaking	Date & type of licence	Article	Quantity per annum
(1)	(2)	(3)	(4)
LICENCES			
Bharat Electronics Ltd Trade Centre 29/4 Race Course Road Bangalore 560001 (Bangalore-Karnataka)	1 8 85 (NA)	Vacuum switching devices	10,000 nos
Madhya Pradesh State Electronics Development Corporation Ltd [illegible]-1/154, Arera Colony Bhopal 462016 (Distt Raisen-Madhya Pradesh)	1 8 85 (NU)	Colour TV receiver sets	50,000 nos.
Max Magnetics Pvt Ltd 70/3 Industrial Area Umbergam 396171 (UT Dadra and Nagar Haveli)	7 8 85 (NU)	Audio magnetic tapes	1080 MRM - 6.3 mm
Videcoon International Ltd 2275 Adat Bazar Ahmednagar 414001 (Distt Aurangabad-Maharashtra)	13 8.85 (NU)	1 Colour TV receiver sets 2. Black-and-white TV receiver sets	40,000 nos 10,000 nos
O/E/N Micro Systems Ltd Vyttila, Tripunithura Road Cochin 682019 (Distt Ernakulam-Kerala)	14 8 85 (NA)	Micro motors/stepper motors	2,00,000 nos.
Uniscans & Sonics Limited [illegible]-110, Sector 17-B Chandigarh 160017 (Distt Patiala-Punjab)	14 8 85 (NU)	1 Brain scanners 2 Body scanners	6 nos 24 nos
Sidkel Televisions Ltd Keltron House, Vellayambalam Trivandrum 695001 (Distt Mallapuram-Kerala)	26 8.85 (NA)	Colour TV receiver sets	10,000 nos
Hindustan Teleprinters Ltd GST Road, Guindy Madras 600032 (Distt Dharmapuri Tamil Nadu)	29 8.85 (NU)	Electronic teleprinters with option, accessories, variants and related generic equipment	[illegible]00 machines
Naresh Chand Jain 150 DDA Office Complex Jhandewalan Phase-1 New Delhi 110055 (Dist Alwar-Rajasthan)	3 9 85 (NU)	Fluorescent tubelights	4 million nos.
Bharat Electronics Ltd Trade Centre 29/4 Race Course Road Bangalore 560001 (Distt Bangalore Karnataka)	5 9 85 (SE)	Television picture tubes	3,00,000 nos. (after expn)
Electronic Corpn of India Ltd Industrial Development Area Cherlapalli Hyderabad 500762 (Distt Ranga Reddy-Andhra Pradesh)	5 9 85 (NA)	Thick film devices	6,00,000 nos
Electronics Corpn of India Ltd Industrial Development Area Cherlapalli Hyderabad 500762 (Distt Ranga Reddy-Andhra Pradesh)	9 9 85 (SE)	Microwave antennae for satellite communication	50 nos (after expn)
Indian Telephone Industries Ltd [illegible] Museum Road Bangalore 560001 ([illegible] Allahabad-Uttar Pradesh)	11.9 85 (NA)	Multi-access rural radio equipment consisting: 1 Exchange and terminals/equipment 2 Base radio equipment 3 Subscriber radio equipment 4 Radio repeater equipment 5 Subscriber radio repeater equipment	Rs [illegible] million ex-factory turn-over value
J.K Batteries (A Division of Straw Products Ltd) Jaykaypur 765017 Rayagada Orissa (Bhopal-Madhya Pradesh)	12.9.85 (SE)	Dry battery cells	120 million nos (after expn)
Electronic Research Pvt Ltd 17th KM, Old Madras Road Bangalore 560049 (Distt Bangalore-Karnataka)	13 9 85 (NU)	1 Deflection components for colour TV receivers comprising deflection yoke, flyback, transformers, purity magnet and focus resistor potentiometer pack 2. Electronic tuner for colour TV receivers	1 million sets
AAG Rola Magnetics Pvt Ltd 147 Poonamallee High Maduravoyal Madras 602102 (Distt Chingleput-Tamil Nadu)	17.9.85 (SE)	Ferrite magnets	1000 tonnes (after expn)
Ralectronics Pvt Ltd Farah Commercial Complex 26-J C. Road Bangalore 560002 (Yeshenthpur-Karnataka)	20.9 85 (NA)	1. Black-and-white TV receiver sets 2 Colour TV receiver sets	40,000 nos. 50,000 nos
Gujarat Industrial Investment Corpn Ltd Chunibhai Chambers Behind Deepali Cinema Ashram Road Ahmedabad 380009 (Distt Ahmedabad-Gujarat)	24 9.85 (NU)	Nickel cadmium cells/batteries (button, cylindrical, rectangular type and for defence purposes)	1 million pcs
Bharat Electronics Ltd Trade Centre 29/4 Race Course Road Bangalore 560001 (Distt Bangalore-Karnataka)	27.9 85 (NA)	Liquid crystal displays	1 million nos.
Teletronix Ltd Bhimtal, Distt Nainital Uttar Pradesh 263136 (Distt Nainital-Uttar Pradesh)	30.9.85 (COB)	Black-and-white TV receiver sets	20,000 nos
LETTERS OF INTENT			
Instru[illegible] Kota-[illegible] Road, Kota R[illegible] (C[illegible] K[illegible])	5.8.85 (NA)	Microprocessor based distributed digital control systems	Rs 100 million
United [illegible] 'United [illegible] Sector 17-B Chandi[illegible] (Distt R[illegible] Pradesh)	5.8.85 (NU)	1. Black-and-white TVs 2. Colour TVs	50,000 nos. 50,000 nos.
Punjab Communication Ltd C-30 Phase-II, Industrial Focal Point SAS Nagar, Punjab (Distt Ropar-Punjab)	5 8.85 (NU)	Analogue digital multiplex trans converter (trans multiplexer type)	200 nos.

(1)	(2)	(3)	(4)
Gujarat Communications & Electronics Ltd Anarag Commercial Centre Race Course Baroda 390005 (Distt Baroda-Gujarat)	5.8.85 (NA)	Low capacity low cost satellite communication terminals	20 terminals
Escorts Electronics Ltd Escorts House, Roshnara Road Delhi 110007 (Distt Faridabad-Haryana)	6.8 85 (NU)	1 Electronic tuners for colour TV 2 Deflection yoke for colour TV 3 Fly back transformer for colour TV	1 million 0 5 million 0.5 million
Kirloskar Electric Co Ltd Industrial Suburb, Rajaji Nagar Bangalore 560010 (Distt Mysore-Karnataka)	6 8.85 (NA)	Micro/minicomputer	Rs 100 million
Indian Reprographic Systems Pvt Ltd 1st Floor, Plaza Cinema Building Connaught Place New Delhi 110001 (Distt Meerut-Uttar Pradesh)	7.8.85 (NA)	Electronic telephone instrument	2,00,000 nos
Larsen & Toubro Ltd L&T House, Narottam Morarji Marg Ballard Estate Bombay 400038 (Distt Mysore-Karnataka)	9 8.85 (NU)	Electronic test and measuring instruments	4 700 nos
Punjab State Electronics Dev. & Production Corpn Ltd 2nd Floor, Bank of India Building Sector 17-B Chandigarh (Distt Ropar-Punjab)	12.8 85 (NU)	Lithium batteries	10 million (3 volts one amp-hour equivalent cells)
Dowell's Elektro Werke Satguru Estate, Off Aarey Road Goregaon East Bombay 400063 (Bombay-Maharashtra)	12.8.85 (NU)	1 Copper cable socket connectors 2. Copper flats, strips and components	1050 tonnes
DCM Ltd (Unit of DCM Data Products) Bara Hindu Rao Delhi 110006 (Distt Solan-Himachal Pradesh)	12.8 85 (NU)	Electronic telex machine	5000 nos
Escorts Electronics Ltd Escorts House, Roshnara Road Delhi 110007 (Backward area in Haryana)	19.8.85 (NU)	1. Carbon potentiometers 2. Carbon potentiometers with switch 3. Single slide potentiometers 4. Dual slide potentiometers 5. Cermet potentiometers 6. Carbon presets 7. Wire-wound potentiometers 8. Plastic conductive-coating potentiometers	7 million nos. 1 million nos. 1 million nos. 1 million nos. [illegible] million nos. 1 [illegible] nos. 1 [illegible] nos. 1 million [illegible]
Dinesh K. Srivastava C/o Mr G.K. Rajagopalan C-320, Defence Colony New Delhi 110024 (Distt Nainital-Uttar Pradesh)	21.8.85 (NU)	Microprocessor based communications controllers	Rs 30 million
BEE Electronics Machine Pvt Ltd 256, Dr A.B. Road, Worli Bombay 400025 (Distt Thane-Maharashtra)	21.8.85 (NU)	Facsimile equipments	2000 nos.
Basu John [illegible] e-Jagannathan 92 Poes Garden Road Madras 600018 (Distt Chingleput-Tamil Nadu)	21.8.85 (NU)	Minicomputer/micro-processor based systems	Rs 60 million
Goodwill Electronics & Engg Co. Pvt Ltd 414-New Delhi House 27 Barakhamba Road New Delhi 110001 (Delhi)	21.8.85 (NU)	Minicomputer/micro-processor-based systems	[illegible] million
Debikay Technologies Pvt Ltd S-323-A Panchsheel Park New Delhi 110007 (Distt Ghaziabad-Uttar [illegible])	[illegible] (NU)	Facsimile equipments	2000 nos.
Rane Brake Linings Ltd Maithri, 32 Cathedral Road Madras 600086 (Any permissible area in Tamil Nadu)	21.8.85 (NU)	Facsimile [illegible]	2000 nos.
Suresh Shrivastava VI/II Mamcol Campus, Kotla Lane New Delhi 110002 (Distt Bahraich-Uttar Pradesh)	21 8 85 (NU)	Electronic microprocessor based control instrumentation comprising transmitters, recorders and controllers	Rs 100 million
T S Grewal 20-Lodhi Estate New Delhi 110003 (Distt Dehradun-Uttar Pradesh)	23 8 85 (NU)	Minicomputer/micro-processor based systems	Rs 100 million
Methodex Systems Pvt Ltd 607-608 Meghdoot, Nehru Place New Delhi 110019 (Distt Indore Madhya Pradesh)	23 8 85 (NA)	Minicomputer/micro-processor based systems	Rs 30 million
Instrumentation Ltd Kota Jalawar Road Kota 324005 (Distt Kota-Rajasthan)	23 8 85 (NA)	Uninterruptible power supply systems of capacities 02 KVA to 500 KVA	Rs 85 million
Best & Crompton Engineering Ltd 29, Rajaji Salai Madras 600001 (Distt Chingleput-Tamil Nadu)	23 8 85 (NU)	Solar thermal systems for domestic, commercial and industrial applications	1000 systems using 25,000 sq mtrs of collectors
T S Grewal 20, Lodhi Estate New Delhi 110003 (Distt Dehradun-Uttar Pradesh)	23 8 85 (NU)	1 Colour TV receiver sets 2. Black-and-white TV receiver sets	50,000 nos 50,000 nos
Kundandas Harikrishandas Sadarangani C/o Royal Electronics Pvt Ltd 46/1 Kangrali, B K Market Yard Road, Belgaum Karnataka (Distt Belgaum-Karnataka)	30 8 85 (NU)	1 Black-and-white TV sets 2 Colour TV sets	10,000 nos 20,000 nos
Punjab State Electronics Dev. & Production Corpn Ltd Bank of India Bldg, 2nd Floor Sector-17B Chandigarh 160017 (Distt Ropar-Punjab)	30 8 85 (NU)	Minicomputer/micro-processor based systems	Rs 200 million
Incomnet India Ltd B-102 Phase-VIII, Industrial Area SAS Nagar Punjab 160051 (Distt Ropar-Punjab)	30.8.85 (NA)	Minicomputer/micro-processor based systems	Rs 60 million
Essen Peripherals Pvt Ltd 7-G, IDC Electronics Complex Gandhinagar Gujarat (Distt Gandhinagar-Gujarat)	30,8.85 (NU)	Winchester disc drives and catridges disc drives	Rs 60 million
Machinery Manufacturers Corpn Ltd Gateway Bldg, Apollo Bunder Bombay 400038 (Calcutta-West Bengal)	30 8 85 (SE)	Matrix printer	Rs 50 million (after exps)
Indo-Swing Ltd Narsapur Road, Balanagar Hyderabad 500037 (Andhra Pradesh)	30 8.85 (NU)	Minicomputer/micro-processor based systems	Rs 100 million
Magnetic Information Technology Ltd B-100 Phase-VIII, SAS Nagar Punjab 161051 (SAS Nagar-Ropar-Punjab)	30.8.85 (NU)	Floppy disc drive and its sub-assemblies (5¼" half weight and 3½")	1,2[illegible] units
Hindustan Brown Boveri Ltd Brown Boveri House Race Course Circle Baroda 390007 (Bombay-Maharashtra)	6.9.85 (NU)	Minicomputer/micro-processor based systems	Rs [illegible] million
Machinery Manufacturers Corporation Ltd Gateway Building, Apollo Bunder Bombay 400038 (Calcutta-West Bengal)	6.9.85 (NA)	Microprocessor based [illegible] computer systems	[illegible] 100 million
Crompton [illegible] Ltd 1, Dr V.B. [illegible] Marg Bombay 400023 (Distt Dhar-Madhya [illegible])	6.9.85 (NU)	Electronic telephone instruments	2,00,000 [illegible]
Vimal Nand[illegible] B-III Malviya Nagar	9.9.85 (NU)	1. Black-[illegible] TV r[illegible]	[illegible],000 nos.

(1)	(2)	(3)	(4)
New Delhi 110017 (Distt Gaziabad-Uttar Pradesh)		2 Colour TV receiver sets	50,000 nos
The Punjab State Industrial Development Corpn Ltd S C O 54-56 Sector 17-A Chandigarh 160017 (Ropar-Punjab)	9.9 85 (NU)	1. Hard disc drives 2 Floppy disc drives 3 Dot matrix printers 4 Daisy wheel printers	Rs 275 million
Multitech International Ltd 8A, Atma House, 1, Tolstoy Marg New Delhi 110001 (Dehradun-Uttar Pradesh)	11 9 85 (NU)	Microcomputer/ microprocessor based systems	Rs 200 million in value
International Computers Indian Manufacture Ltd Ahmednagar Road, Mile Post No 4 Pune (Distt Pune Maharashtra)	30 9 85 (NU)	Minicomputer/micro processor based systems	Rs 240 million in value
J&K State Industrial Development Corpn Ltd Drabu House Ram Bagh Srinagar (Distt Jammu-Jammu & Kashmir)	30 9 85 (NU)	Uninterruptible power supply systems	5 500 nos
Instrumentation Limited Kota Jalawar Road, Kota Rajasthan 324005 (Distt Kota Rajasthan)	30 9 85 (NA)	Drives (all types like winchester, hard disc floppy disc etc of all sizes) Printers (all types like daisy wheel, line dot matrix etc.) Key boards, display terminals	Rs 250 million value
Vishesh Technical & Management Services Pvt Ltd 653, 11th Main Road HAL Second Stage Bangalore 560038 (Distt Tumkur Karnataka)	30 9 85 (NU)	Dot matrix printers and daisy wheel printers	Rs 250 million in value
Kartar Singh Thakral C o Dr N L Hingorani R J Consultants P Ltd J A Mehar House, 1st Floor 15 Cawasji Patel Street, Fort Bombay 400001 (Any permissible location in the state of Karnataka)	30 9 85 (NU)	1. Mini computers/ microprocessor based systems 2 Calculators	Rs 30 million in value 2,00,000 nos
Auto controls (P) Ltd 414, New Delhi House 27, Barakhamba Road New Delhi 110001 (Any permissible area in Delhi)	30 9 85 (NU)	Minicomputer/micro-processor based systems	Rs 60 million
Ambrish Kumar Bansal 2/31 Ansari Road, Daryaganj New Delhi 110006 (Any permissible location in Uttar Pradesh)	30 9 85 (NU)	Modems	10,000 nos
B D Aggarwal & Sons (P) Ltd 29 30 Vasvani Mansion 120 Dinshaw Vachha Road Bombay 400020 (Delhi)	30 9 85 (NU)	Colour television receiver sets	50,000 nos.
The Economic Development Corporation of Goa, Daman & Diu Ltd Trinora Apartments, Near Elderade Theatre P.B No. 316, Panaji Goa 403001 (Goa, Daman & Diu)	30 9 85 (NU)	1 Electronic digital document 2 Transmission equipment 'facsimile'	2000 nos.
J&K State Industrial Development Corpn Ltd Drabu House, Rambagh Srinagar, (Distt Budgam-Jammu & Kashmir)	30 9 85 (NU)	VHF mid band communication sets	Rs 30 million in value

LICENCES AND LETTERS OF INTENT CANCELLED

Name of Undertaking	*IL dated*	*Articles*
LICENCES CANCELLED		
Ambalal Sarabhai Enterprises Ltd Baroda	15.3.73 (Revoked)	Television receivers
[illegible] Sarabhai Enterprises Ltd	3.11.67 (Revoked)	Television receivers
LETTERS OF INTENT CANCELLED		
Surya Prakash Srivastava Saubhagyavati Industries Jaipur	3.3.64 (Cancelled)	Electronics components chemically milled
R C Exports Pvt Ltd Bangalore	14 10 82 (Cancelled)	Digital blood pressure instruments and digital human thermometer
Orr cee Electronics Ltd Bangalore	16 1 82 (Cancelled)	Printed circuit board for 100% export
S A Software Technology Pvt Ltd New Delhi	30 6 84 (Cancelled)	Development of computer software
Delview Electronics (P) Ltd New Delhi	29 7 84 (Cancelled)	Pre-recorded video cassettes
Kothari Electronics & Industries Ltd Madras	1 11 83 (Cancelled)	Colour TV receiver sets
S.D Gupta W-63 Greater Kailash-2 New Delhi	22 3 82 (Cancelled)	Printed circuit board etc
Indus Technologies Inc Monroeville, PA 15146 USA	28 2 85 (Cancelled)	Computer software
Ralectronics Pvt Ltd Bangalore	2 2 85 (Cancelled)	Black-and-white TV sets
Ralectronics Pvt Ltd Bangalore	23 9 83 (Cancelled)	CTV sets
Punjab State Industrial Development Corpn Ltd Chandigarh	20 4.81 (Revoked)	TV glass shells
Mitgart India Ltd SAS Nagar Punjab 161051	31 12 83 (Cancelled)	Magnetic cores & ceramic components etc
Crompton Greaves Ltd Bombay	4 4 82 (Cancelled)	Static AC variable speed drive system

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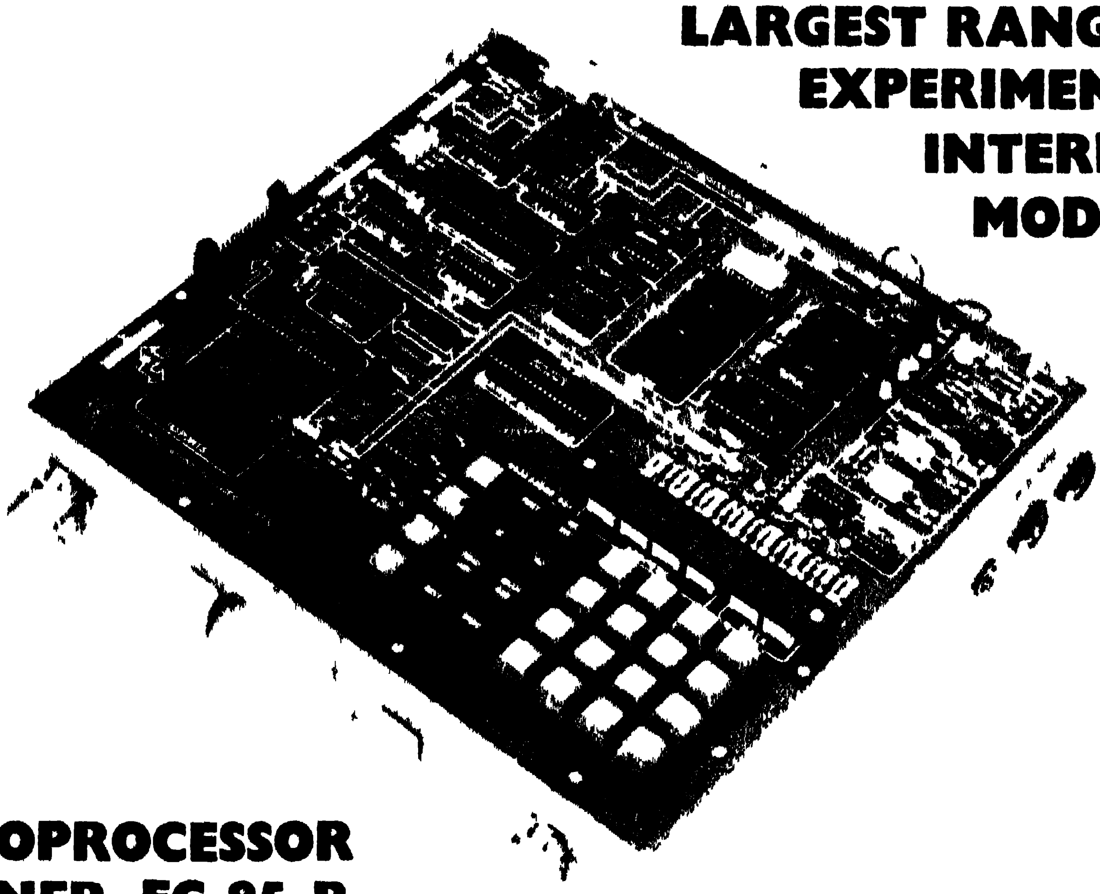

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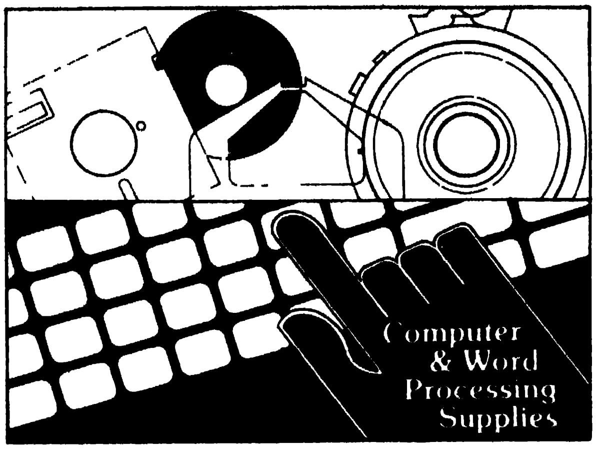

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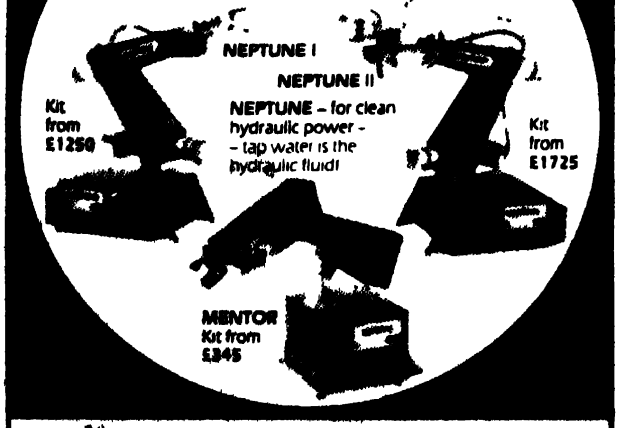
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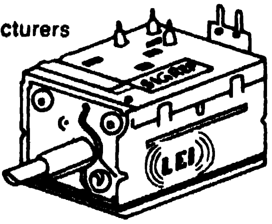

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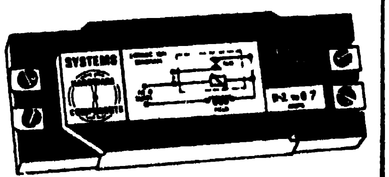

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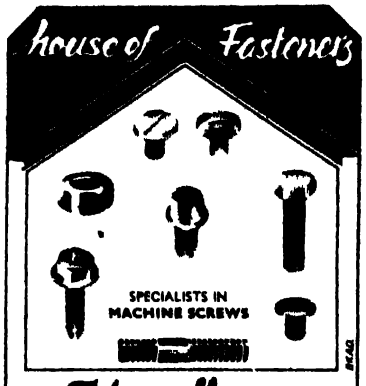

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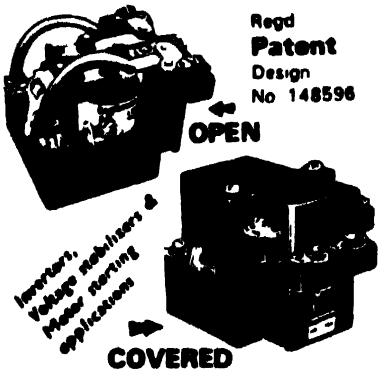
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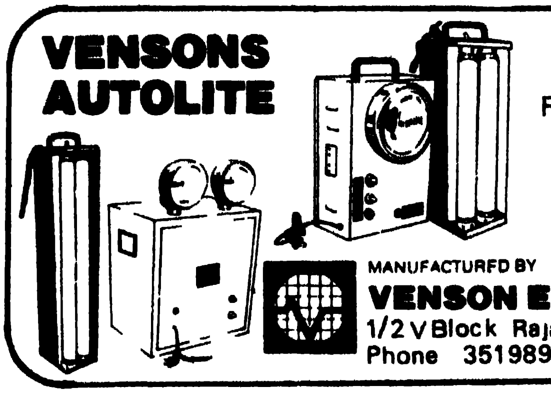

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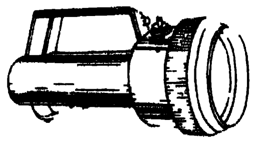

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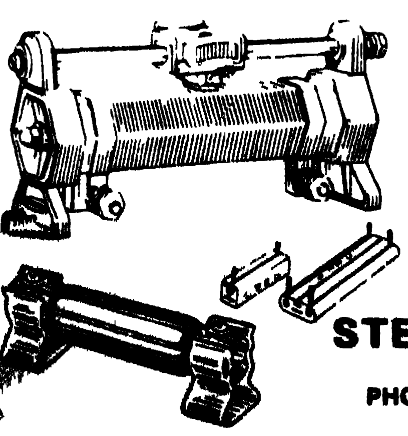

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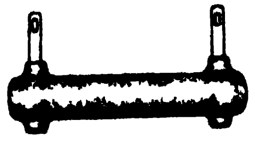

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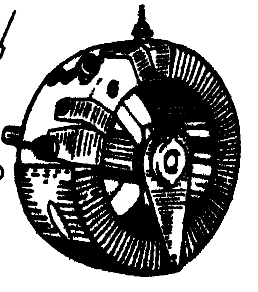

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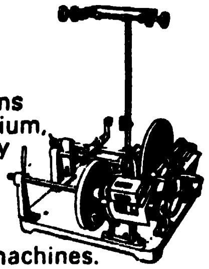

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Advertisers' Index

ABL.Capacitors	53
ASE Ltd (Systronics)	82
Allied Publishers	6
Amar Radio Corporation	68
Ambimat Electronics	40
Aradhna Electronics	58, 74
Asoka Industries	29
Associated Electrical Agencies	7
B R Enterprises	110
B T Solders	86
Bajaj Bros	88
Bajaj Electricals	30
Balaji Engineering	51
Brisk Electro Sales	25
Business Promotion Bureau	10
CTR Manufacturing	5, 81
Component Technique	90
Consultancy Bureau	24
Cresta Instruments	26
Cycl-O Computers	6
Desai Electronics	88
Dominion Radios	26
ECIL	41
Elcompo	75
Electro Systems	67
Electronic Instruments & Controls	68
Elnova	89
Esarem Electronics	5
Geeta Electronics	42
Golite Electricals	88
Grafica Display	110
Gupta Industries	86
IEAP	82
ITT, West Germany	IV Cover
Inde Associates	9, 13
Integral Systems	6
International Marketing Corporation	44, 45
J.J. Electronics	26
Kadimi International	80
Keith Electronics	105
Khanna Traders	12
Kusum Sales	74
Kwality Electricals	88
Labgear India	29
Leader Electronics, Japan	32
Leader Electronics	74
Masibus Electronics	42, 90
Micro Advance	20
Motwane Manufacturing	37
Murugappa Electronics	19
O/E/N Connectors	87
Oberoi Electronics	25
Oil & Natural Gas	31
Oswal Electronic	52
Perfect Electronics	4
Poonam Industrial Research	3
Professional Electronic Products	69, 101, 109
SGS Semiconductor, Singapore	II Cover
Saini Electronics	110
Scientific Mes-Technik	79
Series Audio Systems	III Cover
Shiltron Electronics & Engineers	38
Small Industry Research	8
Spectron Electronics	40
Technology & Research	110
Texonic Instruments	108
Time Engineers	67
Trans Marketing	16
Unique Systems & Controls	68
Vasavi Electronics	26
Vinytics	59
Vishal Agencies	68

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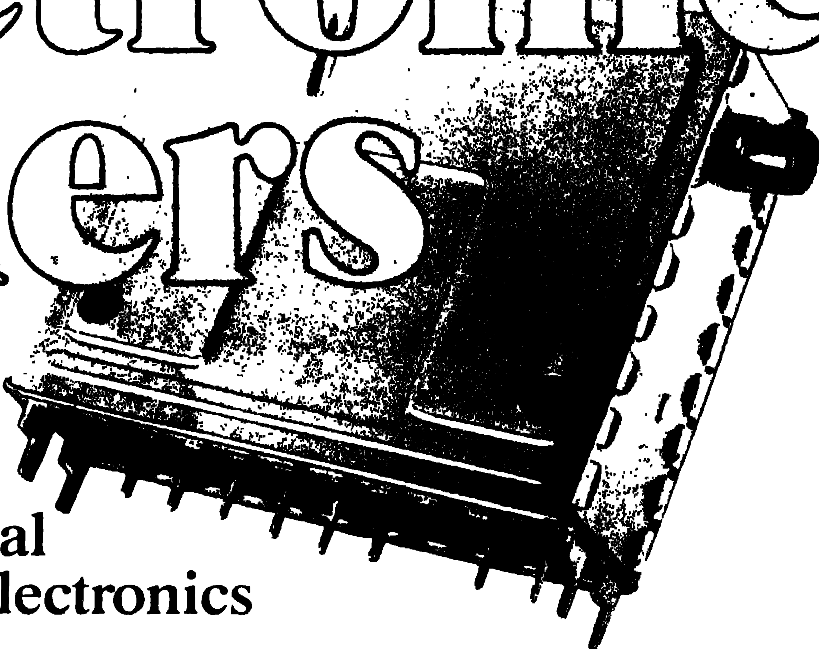

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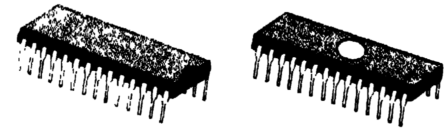

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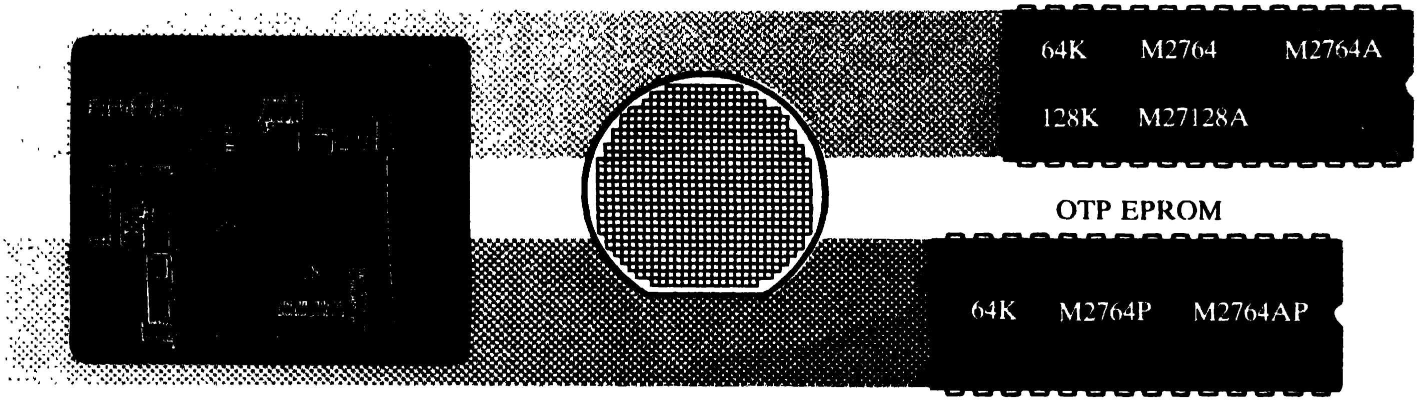

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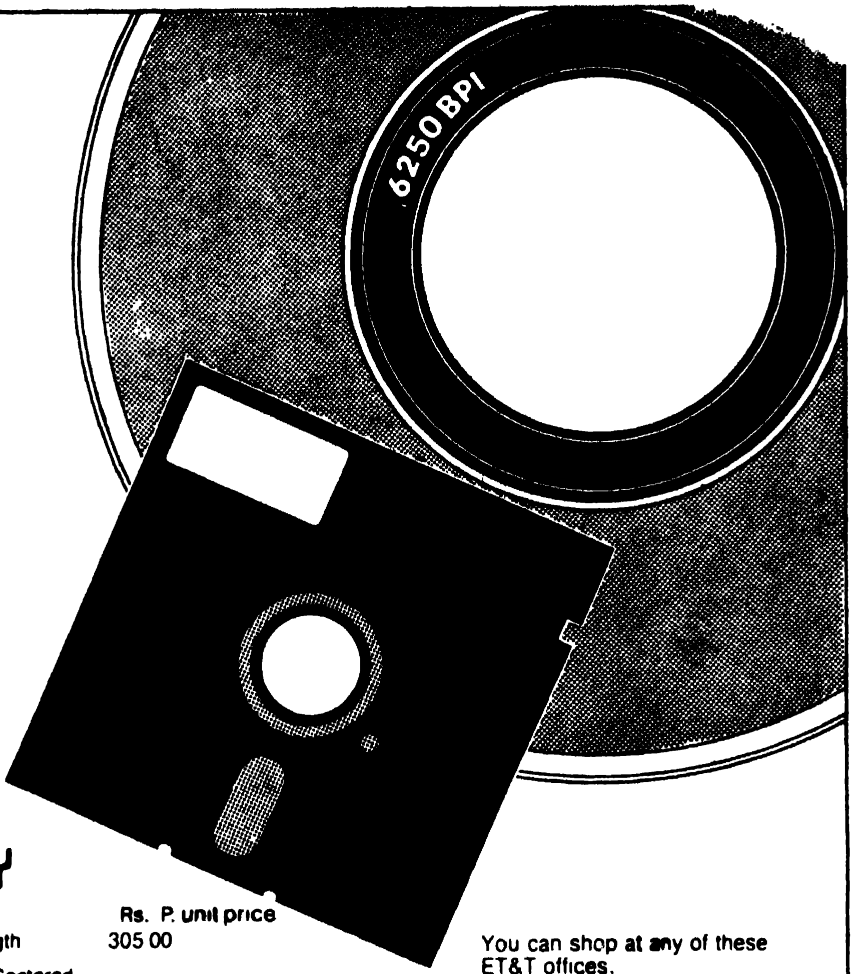

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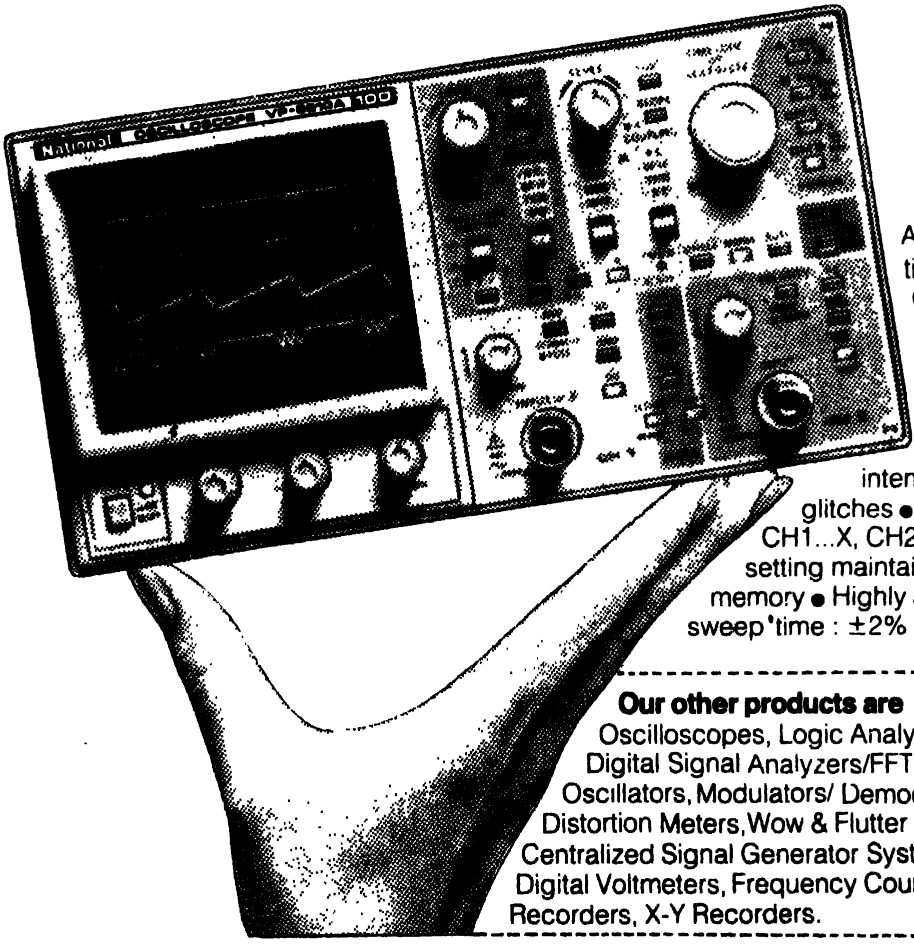

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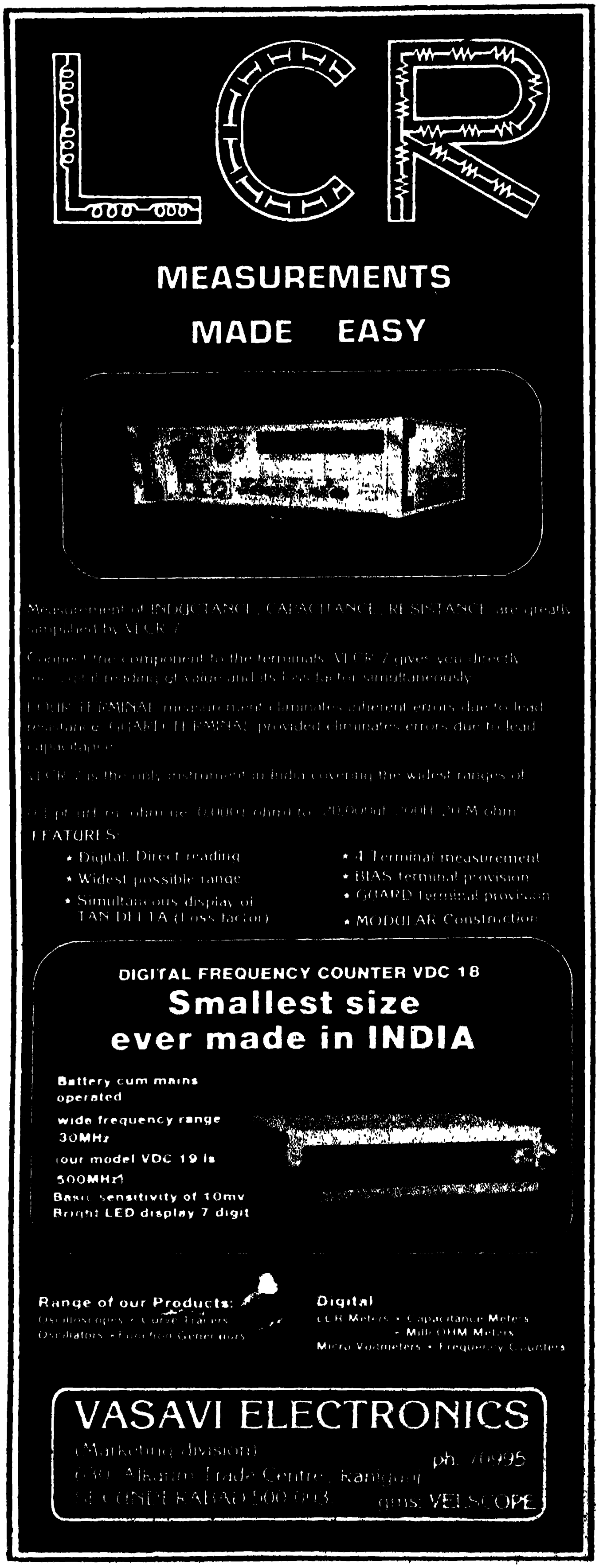

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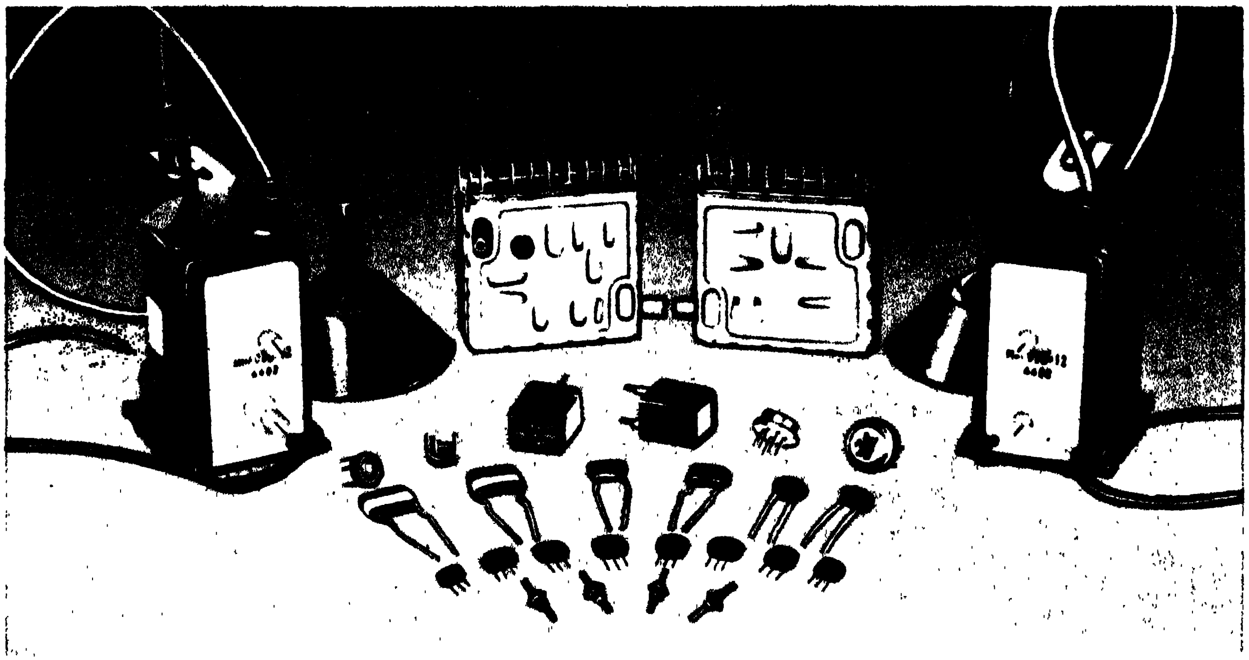

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contents

Vol. 18 No. 3 MARCH 1986

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SUBSCRIPTION RATES IN INDIA
(From March 1, 1986)

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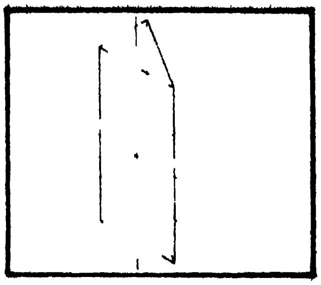
The Saga of Crystals



19 From the relatively humble beginning as a speciality technology, quartz crystals soon conquered the world of precision technology. This article studies in detail the qualities that make quartz, as also other crystals, so indispensable

—*A V. Jacob*

Electronic Warfare

65 A good part of a country's defence effort centres around monitoring the enemy's movements during war and peace time. This no doubt is done using modern electronic weapons. But how these weapons are used as a key to combat survival is what this article aims to explain

—*Satish Jain*

Circuit Ideas

83 The Special feature of the month. Packed with 14 easy-to-make and inexpensive circuits to catch the imagination of the electronics hobbyists who prefer to make their own electronic gadgets

19 The Saga of Crystals
—*A.V. Jacob*
31 Crossover Networks
—*Jasvinder Osan*
40 Development and Perspective of Bulgarian Electronics
—*Special Correspondent*
46 Program for Design of Power Transformer
—*Anil Kumar Malik*
50 Comparative Study of Computer Languages—Part IX
—*R. Ramaswamy*
60 Microprocessor Control of Stepper Motors
—*Prof. V.V. [illegible]*
65 Electronic Warfare—A Key to Combat Survival
—*Satish Jain*
75 A Game of Steady Hands
—*S. Chakraborty*
79 Quick [illegible] and [illegible] Tester
—*[illegible] Saurabh*

FEATURES

13 Letters
17 What's New
43 Computer Corner
74 Electroons
75, 79 Construction

83 Special Feature
CIRCUIT IDEAS

99 Product Profiles
103 Book Reviews
106 Company Profiles
108 Facts & Figures
111 Electronics Mart

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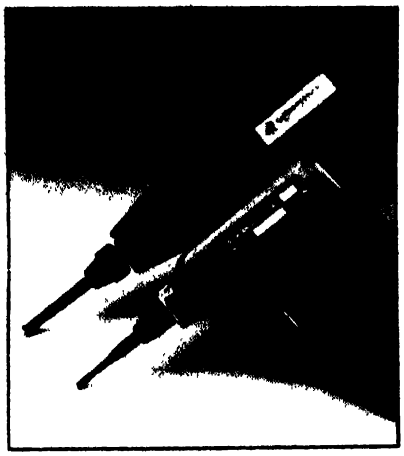

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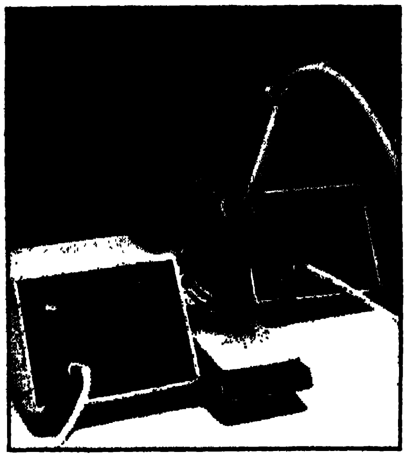

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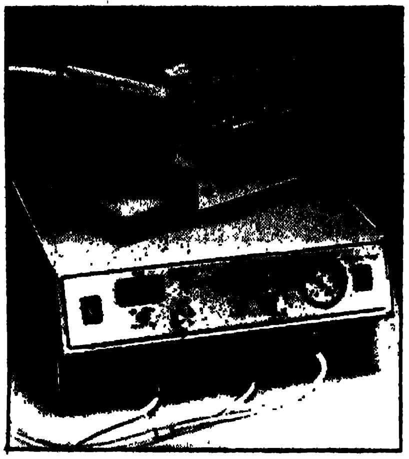

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KAVERI

Letters

Signal Generator

First of all I must congratulate Mr Alegaonkar Girish Hari for contributing the article on Solidstate AF-RF Signal Generator' in Dec '85 issue.

I request Mr Hari to give necessary details of coil data and modifications needed to extend the range of the signal generator to 300 MHz.

I also request him to contribute further, articles on solidstate FM signal generators and solidstate oscilloscopes, as CR tubes from Punjab Display Ltd are now freely available.

The 'Inexpensive Multitester' and 'Circuit Ideas' in Dec '85 issue were very good However, the on/off switch denoted as S2 on page 78 should be marked as S1, and S1 shown should be marked as S2.

R.S. SHARMA
Aligarh

□ Please refer to pages 61-63 of Dec '85 issue.

By using a 2-pole, 4-way band switch, we can obtain signals in the four bands from 400 kHz to 23 MHz. Would you please let us know how an AF signal of 400 Hz could be obtained? In Fig. 2 of the same text, mention has been made of "10 turns loop over ferrite rod." The SWG of the wire and how the loop could be connected in the circuit may also be indicated.

S.G. JAYACHANDRAN
Madras

The author, Mr G.H. Alegaonkar, replies:
In my signal generator, it is not possible to extend the frequency range up to 300 MHz, with only minor modifications. So I will suggest that readers refer to the circuit of the local oscillator used in TV VHF tuners which is closer to 300 MHz.

AF signal of 400 Hz is clearly mentioned as AF OUT in Fig. 2 on page 62, that means it is available from pin 3 of IC NE555 through C13 (0.01μF) capacitor.

The 28 SWG enamelled copper wire or PVC coated wire can be used for modulated RF output. So it should be connected between RF output and common ground, as shown in Fig. 2 on page 62, to radiate the modulated RF signal.

Speed of 6502

Speed of 6502 is quite comparable to that of 8085A and it is not a slow processor. Here it is worth noting that:

1. 4MHz crystal along with a 8085A microprocessor gives a system clock of only 2 MHz. The division by 2 is internal to the microprocessor.

2. Even simple instructions in 8085 require 4- or 7-clock cycles, thus taking about 2 to 3.5 microseconds. Complex instructions may require 16 to 18-clock cycles, i.e. they would be executed in 8 to 9 microseconds.

3. In comparison, 6502 takes only 2-clock cycles for simple operations, thus requiring only 2 microseconds. The complex instructions take 7-clock cycles or 7 microseconds. Execution of long programs is speeded up due to overlap of instruction fetch and execute cycles in adjacent instructions

4. Thus the time taken to run two similar programs on 1MHz 6502 and 4MHz 8085A would be almost same Special features of 6502 may even speed up the operation in certain types of programs.

5. 8085A operating with a 6MHz crystal would be faster than 6502 by about 30 per cent, but 6502A and 6502B operating at 2 and 3MHz will definitely be like Z80A and Z80B operating at 4 and 6MHz and 8085A with crystals of 8 and 12MHz respectively.

6. 1MHz clock of 6502 and 4MHz crystal (2MHz clock) for 8085A are optimum for the slow memories, EPROM in particular Higher clock frequencies require careful choice of memories or use of wait states which need extra hardwares.

R.N. MISRA
Ahmedabad

The author, Dr K. Padmanabhan, replies:
I have written that "6502 is a slower processor because it generally uses a 1MHz clock frequency...." Thus if the 8085 takes only 0.5μs for each tick of its clock, the 6502 takes 1.0μs for the tick of its clock—hence slower. I am however aware that by performance, the 6502 is not bad.

People say that an express train runs faster than an express bus. But we know that one reaches the destination sooner by bus than by train Likewise, the 6502 runs programs faster if efficiently written. As a comparison, 'memory to memory move' time for each of the processors is like this:

8085	Z80	6502	6809
8	6.4	8	10μs

And in the next sentence, I had also mentioned: "However 2MHz chips (6502A) and 6502B (3MHz) chips are also available "

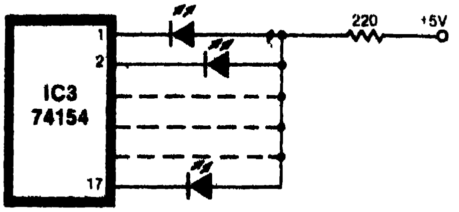
To add to what Mr Misra has mentioned in his letter, the 6502 allows codes to be written more efficiently (i.e. less memory) because of its powerful addressing modes, thereby running programs really faster.

In a full microcomputer project article to be published this year, I employ a 6502A!

Roulette Wheel

This has reference to Mr A.V. Jacob's construction article 'Electronic Roulette Wheel' in the Oct. '85 edition of EFY. I have long been interested in just such a project and the stumbling block has been a simple VCO (voltage controlled oscillator) whose frequency extends down to zero. It is a tricky problem and Mr Jacob has provided a really neat solution.

While his VCO is simplicity itself, he has unnecessarily complicated the last section by including a series resistor for each of the LEDs. This gives rise to 16 resistors, the soldering of which is not only laborious but also avoidable. Since only one LED is lit at any instant, one common series resistor near the power supply is sufficient, as shown below. Fortunately, this change can be incorporated without any modifications to the PCB.



The IC 74154 is a rather costly item, but where 16 LEDs are required to be demultiplexed, there is no other choice.

In passing, allow me to congratulate you on bringing out such a fine magazine and exhort you to do better.

M. FARAHAD ZAMA
Waltair (A.P.)

The author, Mr A.V. Jacob, replies:
A barrage of letters loaded with the 'single resistor' concept have been received. However, it is not an accident. Over simplification may reduce life of the device. In the single resistor arrangement, the current flows through a single resistor all the time. The effect is greatest when the current is maximum or when the device is forced to sink from an external DC source, as in the given design

Suggestions and Comments

I am a final year student of engineering and have been a regular reader of your magazine since last four years. This is the only magazine I found arriving before time. The magazine has improved its standard to a considerable extent during the course of last few years. But ocassionally, a sub-standard article or a repetition spoils all the fun.

I honestly appreciate the variety of information provided by the magazine through various regular features like Whats New, Product Profiles, Company Profiles, Book Reviews, Facts and Figures etc.

Here I was wondering if you could possibly start something called Ham's Shack—a corner for radio amateurs containing a few tit-bits personal experiences of hams and various tricks of the trade used to over-power the famous Murphy's Law. I am sure many of the hobbyists will be benefitted by it. (Not to talk of those thousands of Hams and SWLs among EFY readers, who will be overjoyed.)

The Product Profiles feature interests me the most. But I find it highly annoying when such useful products are described there without any information regarding their price.

ASHISH SAXENA
Indore

□ I am an electronics hobbyist and a regular subscriber of your magazine. I appreciate its contents very much.

I suggest you to start a Project Report column in your magazine, in which project reports for setting up electronics industrial units in small scale sector may be published The project reports should consist of the estimate machinery required cost of machinery total cost of project feasibility and addresses of raw material and machinery suppliers

As all kinds of readers including hobbyists businessmen traders and entrepreneurs read your magazine such information will be quite useful to them

PARVEEN KUMAR JAIN
Alwar

□ In September 1985 issue I noticed some mistakes The circuit diagrams of Electronic Auto Dipper and Automatic Mast Light Switch were interchanged Please try to avoid such printing mistakes I hope EFY becomes a zero error magazine

K V N R KRISHNA
Eluru

□ I am a reader of your electronics monthly since past two years EFY has been a unique magazine in the true sense It has been giving very valuable information on almost all aspects of everyday electronics

I suggest you to start new columns giving courses in electronics for beginners and servicing of electronic equipments (like radio TV video etc)

Why does Circuit Ideas section not contain easy to construct practical entertainment circuits?

T L J SARAVANA KUMAR
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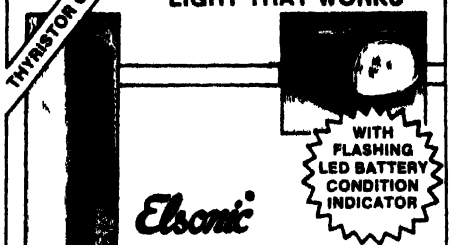

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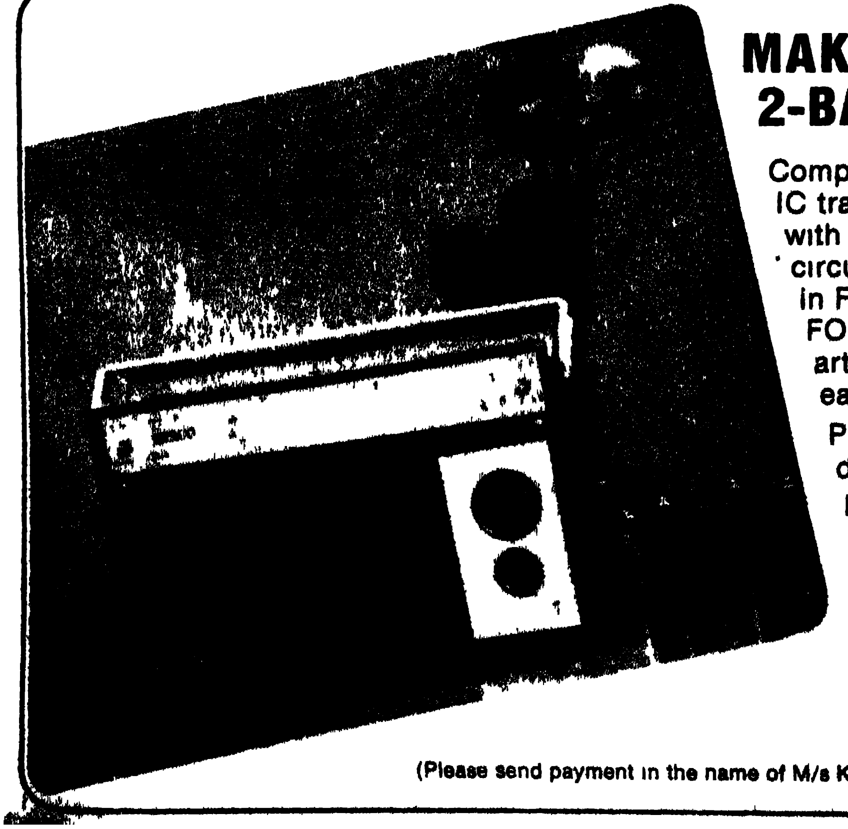

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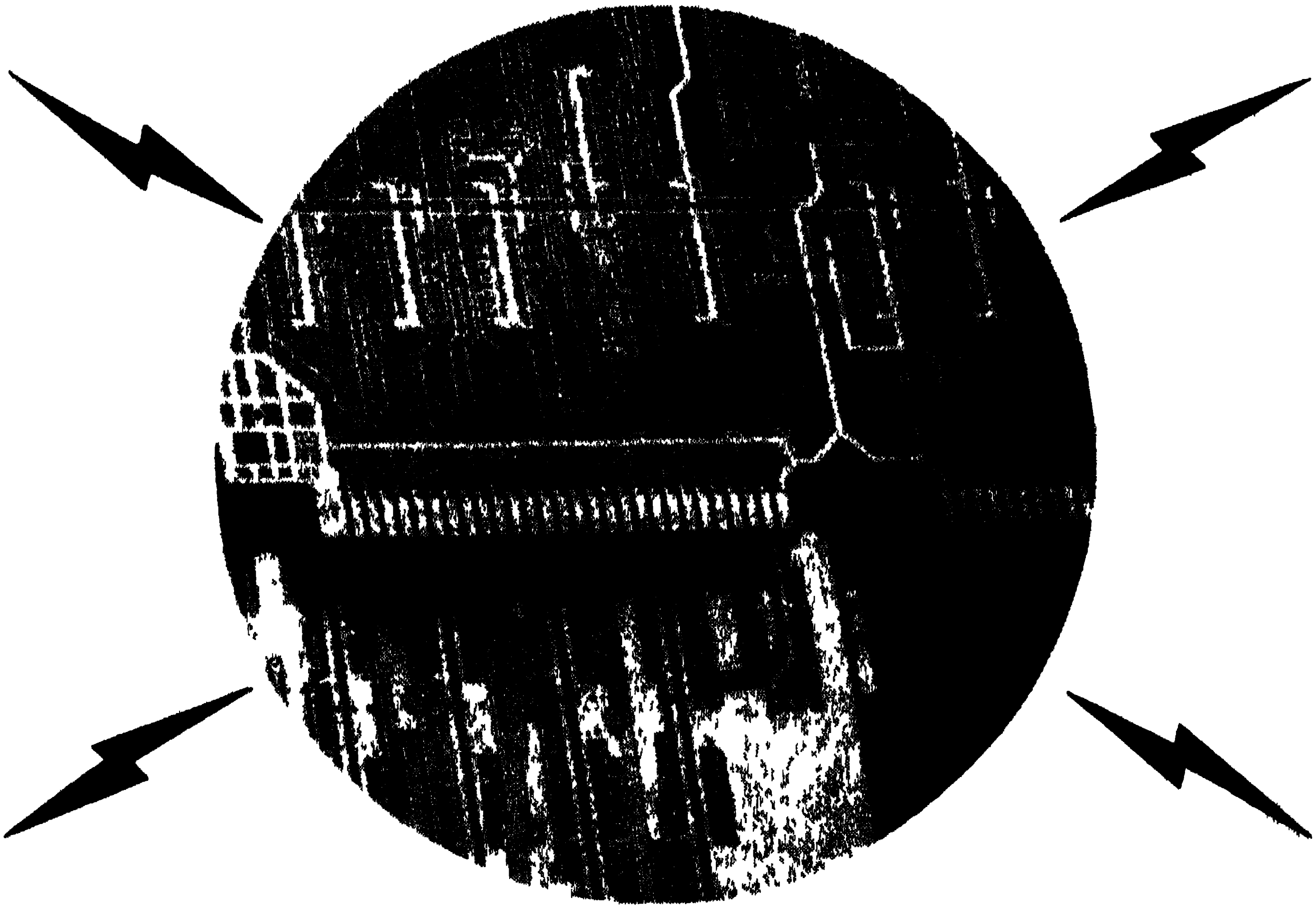

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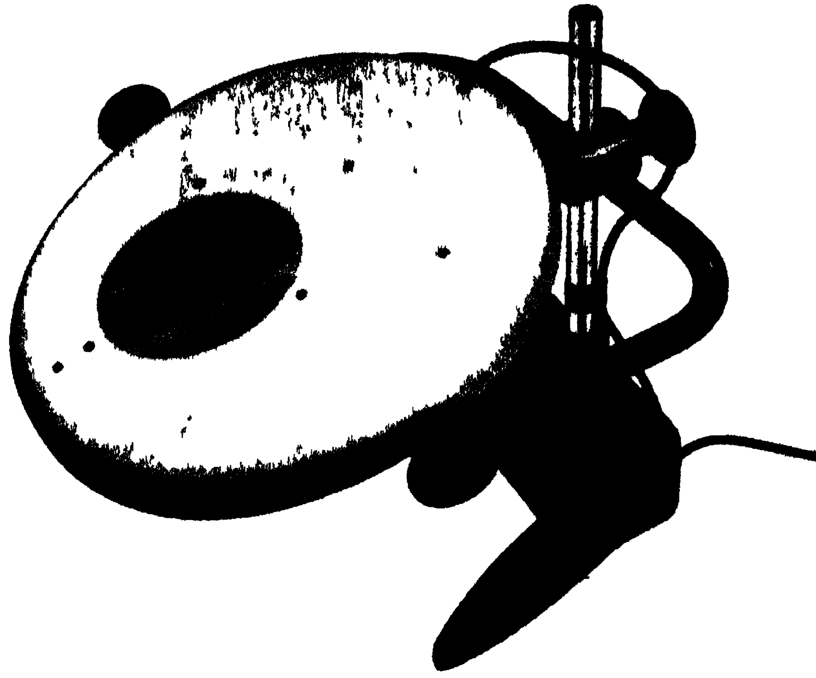

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IN INDIA....

TV—from elite medium to mass medium

The spectacular boom in the production of TV sets during the last two decades has transformed television from the elitist status symbol into a mass medium.

From the inconsequential figure of 400 sets about 20 years back, the figure rose to 455,000 in 10 years and stood at 5.2 million in early 1985. The total number of TV sets in the country is now a leviathan six million, projected to go much higher in the next few years.

The steep rise in the number of TV sets in the country can also be traced to the rapid expansion of the transmission facilities of Doordarshan since 1982.

Beginning with only 16 transmitters in 1982, situated mostly in the metropolitan cities and state capitals, the number rose to 41 at the time of the Asian games. Gathering momentum throughout 1983 and 1984, the number rose to 180.

Last year, two million sets were bought from shops that mushroomed all over the country. The total is expected to rise to 30 million by the end of the Seventh Plan.

Tax relief to Rajasthan electronics units

The Rajasthan government has granted a tax holiday to new electronics industries and has offered a new package of financial incentives to existing industries to give a fillip to the electronics industry in the state.

All existing units will now pay Rajasthan sales tax and central sales tax of only four per cent as a result of these tax relief measures, in effect from January 16, 1986. The reduced rates will prevail for a period of five years till March 31, 1991.

The tax holiday given to new companies will also be in force for the entire duration of the Seventh Plan subject to the condition that they start commercial production during the period. Electronic industries which expand their capacity to the extent of 50 per cent or more will also receive this tax holiday for the expanded capacity.

On behalf of the government, RIICO (Rajasthan State Industrial Development and Investment Corporation Ltd) is also providing additional incentives to electronics industries, such as priority in allotment of land, 20 per cent rebate on cost of land, subsidy on feasibility study, reduction in cost of land on timely start of production, liberal equity participation, subsidy on knowhow from national laboratories and escort services.

Restrictions on CTV imports

The Finance Ministry has amended the baggage rules to restrict the duty-free allowance in the case of passengers bringing colour television, video cassette recorder/player or video camera, to Rs 500. As a result of the new rules, effective from February 15, 1986, import duty will be charged on the value of these products in excess of this amount.

According to an official release, the total free allowance for all articles of bonafide baggage will, however, remain at the present level of Rs 1250. Tightening the allowance rules comes in the wake of strong plea by the indigenous industry to restrict such imports, particularly of CTV sets. The facility of duty-free allowance has been used for quite sometime to indulge in trading of imported sets, injuring the local industry.

Stress on technology import criticised

Mr Sam Pitroda, adviser to the Centre for Development of Telematics (CDoT) took to task the import lobby in the country for its persistent stress on borrowing technology and blamed it for "transplanting" technology rather than "transferring" it.

Speaking at the Annual Telecom Convention organised by the Indian Telecommunications Service Association (ITSA), Mr Pitroda stressed the need for greater self-reliance in the field of high technology. Citing an example, he said that the country had paid heavily for the purchase of E 10 digital switching technology from CIT-Alcatel of France, and now that it was ours, we should capitalise on it instead of continuing to rely on the foreign company.

Similar sentiments were expressed by Mr K.P.P. Nambiar, chairman and managing director of the Indian Telephone Industries. Mr Nambiar said that as a result of dependence on foreign kits, the indigenous colour television industry had yet to take root with the import content of the sets being as high as 60 per cent. The calculator industry too had been totally 'finished' by this factor, he claimed.

Delivering the key-note address at a seminar organised jointly by the Association of Indian Electronics Industry (AIEI) and the Karnataka State Electronics Development Corporation Ltd (KEONICS), he said that although the total production of electronics goods had risen from Rs 3640 million in 1975 to Rs 21,000 million in 1984, the real increase in value was minimal due to kit imports.

TV makers to fight FERA companies' entry

Television manufacturers are planning to go to court over the government's decision to allow companies with foreign equity up to 40 per cent to manufacture TV sets, according to Mr Sunder T. Vachani, president, Indian Television Manufacturers' Association (ITMA).

The government decision stipulates that companies with foreign equity up to 40 per cent would be allowed to manufacture TV sets provided they agree to sell 25 per cent of their output in kit form to small scale units for five years and do not use foreign brand names.

Mr Vachani claimed that the stipulation to supply kits to small units was not an obligation to foreign equity companies but a "favour". He said the performance of the foreign equity companies in other areas of entertainment equipment over the years had shown that their products were 20 to 30 per cent costlier than those made by small companies. Similarly, these companies would sell TV receivers at prices much higher than the market prices.

The ITMA president demanded that the policy be changed in the public interest.

TGK to chair international meet

Mr T.G. Krishnamurthy, a renowned biomedical engineer and a regular EFY contributor has been invited to be the Theme Coordinator Chairman for one of the main themes—health care technology in the third world nations—during the 8th Annual Conference of the IEEE Engineering in Medicine and Biology Society at Dallas, USA in November 1986

Mr Krishnamurthy will be required to plan and organise three sessions during the conference and collect about 30 invited papers from health experts from Asia and Africa

As reported in the February issue of EFY, this conference is the world s largest meeting in the area of biomedical engineering and computing

Elcina awards for 1985

In keeping with its tradition to encourage R&D, import substitution and export of electronics goods, Elcina is giving the following awards for 1985 to the best entries

1 Research & development
2 Import substitution
3 Exports
4 Indigenisation of capital goods for manufacture of electronic goods

The awards instituted in 1976 for the electronic components industry were thrown open in 1983 to the entire electronics industry Even units outside the membership of Elcina are eligible for participation

....AND ABROAD

ITU efforts to develop Albanian telecom system

For some years now, the ITU (International Telecommunication Union) has been involved in the development of telecommunications in Albania and has established increasingly close cooperation with the Albanian telecommunication authorities One of the functions of ITV in the development field is to serve as executing agency for technical cooperation projects funded among others by the UNDP (United Nations Development Programme)

Its role was exemplified when GTE (Italy) and Alcatel-Thompson (France) signed contracts for the supply of telecommunication equipment worth US $880,000 in December last, to Albanian firms

T[illegible] project jointly financed by the UN[illegible], and the Albanian government, aims at laying the foundation for a national and international telecommunication network and completing the Albanian master plan for the development of telecommunications Its equipment and sub-contract component accounts for nearly 1 825 million US dollars

Automatic machine to double-dip PCBs

An advanced machine which automatically applies two protective coatings of varnish or similar material to printed circuit boards (PCBs) is available from a British company—Robnorganics Systems Ltd

The double-dip machine is designed to apply the extra coating, with a controlled drying period between immersions, without consuming the additional time and labour required by a single-cycle installation

The overall coating achieved by the double immersion process protects the boards from moisture and vibration stress, it is claimed

Most of the pneumatically powered machine is in stainless steel for durability and easy cleaning

Korean firms' emphasis on high-tech

The Korea Electronics Show (KES) was held in Seoul from 18 to 23 October last year High-tech products such as the laser printers, laser pickups, plastic magnets, laser oscillators, 8 75cm FDDs, 8 75cm HDDs, 64k SRAMs and various other products were on display These new products highlighted the technological advancement made by the Korean electronics firms in the recent times

In the consumer electronics sector also, new products such as the 8mm VTRs, hi-fi multivocal system colour TVs, CD players, microwave ovens and the so-called third generation digital and multilingual colour TVs introduced recently, were displayed

The spectacular technological advance, as was evident at the show, has been made possible by the huge investments made in the semiconductor industry Due to these investments a Korean firm developed the 256k DRAM early last year following the 64k DRAM in 1983 Korean chip makers are presently working on a 1-mega DRAM which will open the gates for the VLSI chip age in the country

Voice mail equipment

Toshiba Corporation of Japan has heralded a new era in communication by introducing what is called the 'voice mail equipment This equipment eliminates the drawback inherent in the normal means of message communications such as telephone in that it does not require both the parties, the caller and the called to be present at the same time

This voice mail equipment enables the caller to leave audio messages which can be heard by the called at a later time The equipment works with a private branch exchange

It performs a variety of incorporated services in response to requests issued from standard telephones and multifunction telephones A broad range of services is available by combining basic services with supplementary services such as time-specification and multiple-destination broadcasting function

The company is presently conducting repeated test services When this equipment comes of age it will add a new dimension to effective office automation

Communication Integration trend in Japan

After the New Telecommunications Law was brought into effect in April 1985, terms such as fascimile with built-in telephone and PC telephone are becoming more familiar in Japan The market is being flooded with various compound telecommunications terminal products manufactured by Nippon Telegraph and Telephone Corporation and others

Though this trend of communication integration is in its infancy in Japan, in the USA where it is termed integrated voice data terminal (IVDT), it is spreading rapidly IVDT is used in a narrow sense, limiting the integration to a personal computer with a telephone

Among the products already on the Japanese domestic market are memo telephones such as Matsushita Graphic s Panamend-107 and Tokyo Electric s PN-1000, telephone-equipped PCs such as Oki Electric Industry's portable computer COM 7, NEC's desktop computer PC-8801 MK IITR. Also on the market are an integrated unit of telephone, computer and word processor like NTT's COMEXCEL and telephone equipped fascimiles from Mitsubishi Electric, Fujitsu, NEC and Matsushita Graphic.

The Saga of Crystals

A.V. Jacob

In recent years, demand has been so high for nearly all technology-related products that just about any product implemented could find a ready customer base, one way or the other. It is now apparent that the technology is where the size shrinks and the numbers expand. Consequently, the new products disappear from the scene, falling prey to the same logic.

But, there is only one side of the story to quartz crystals. After a relatively humble beginning as a speciality technology, quartz soon conquered the world of 'periodicity' And now, it is moving on to the technology of choice for custom and semicustom, very large-scale integration applications.

Quartz was introduced into the wrist watch by Bulova in the first quarter of 1970s in the USA. Then it fetched a handsome 395 US dollars. This luxury was affordable by only the rich elite of the society. The power for the watch was derived from button cells which were said to last for one year. It was claimed that these wrist watches would gain or lose no more than one to two seconds per week when worn. The driver IC was fabricated by Intersil of Cupertino, California according to the specifications of Bulova. The subminiature crystal used in the wrist watch had a frequency of 32768 Hz which was then divided by the IC circuitry to $341\frac{1}{3}$ Hz by a factor of 96. The driver IC was also a breakthrough since it used a single plastic-encapsulated, low-threshold CMOS genre.

The noble trio

Piezoelectric effect has been exploited since its discovery in 1880 by Pierre and Paul Curie. Electronically piezoelectric materials are termed as the royal sandwich between mechanical and electric forces. Rochelle, tourmaline and quartz are the noble trio. If pressure is applied to these crystals in certain directions a proportional amount of electric voltage is produced. Soon after this discovery, the reverse effect also came to light. If an electric field is applied to these crystals, they either expand or contract.

Crystals are neutral due to the presence of equal number of positive and negative charges. The 'centres of gravity' of positive and negative charges are stationary relative to each other. A relative motion of these centres due to physical movement caused by compression or expansion results in the production of electric current for the time in which the charges are in motion. However, the availability of current for the external circuits is very much limited but the potential difference that is developed in the crystal is sufficient to set-up a visible arc, a few centimetres in length.

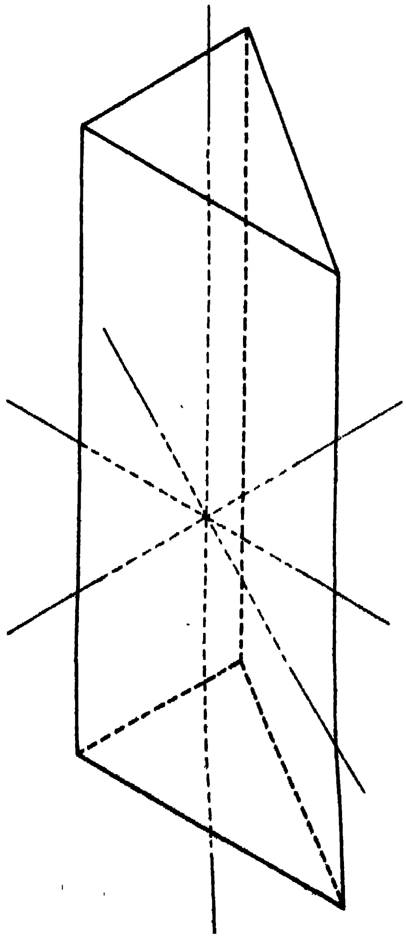


Fig. 1: The tourmaline crystal structure.

The lack of a centre of symmetry in the crystal is the root cause of piezoelectric effect. The compression and expansion of the crystal can be easily identified by the polarity of the potential developed by the crystal. Thus, a variable pressure can be translated into its electrical equivalent without missing any of its finer details. Conversely, the crystals are equally vulnerable to the changes in the applied voltage across them which induces a physical movement of compression or expansion to the crystals.

Rochelle salt ($NaKC_4H_4O_6 .4H_2O$ or sodium potassium tartrate), belongs to crystallised orthorhombic class. (The orthorhombic system has three axes, all at right angles to each other and having different lengths. Common forms are the four sided prism and the flattened tabular crystal.) The Curie brothers used rochelles in 1880 to study the behaviour of piezoelectric materials. In crystalline form, rochelle salt can have a dual life depending on the temperature. It is monoclinic (also a three-axes system having different lengths with two axes inclined at an angle other than 90° and the third at right angles to the other two) in the range -18°C to 23.7°C and orthorhombic outside this range. In the latter state, the field produced in the x-direction by shear strain, which is about the x-axis, is fairly independent of temperature over a limited range. (Thus the X cut crystals are most useful in applications like gramophone pickup, microphones and similar transducer applications.)

Prominent piezoelectrics

A few more prominent piezoelectric crystals that emerged in the late forties were: ammonium dihydrogen phosphate or ADP ($NH_4H_2PO_4$), potassium dihydrogen phosphate or KDP (KH_2PO_4), ethylene diamine tartrate or EDT ($C_6H_{14}N_2O_6$) and dipotassium tartrate or DKT ($K_2C_4H_4O_6 . \frac{1}{2}H_2O$). Since ADP is free from water of crystallisation it does not dehydrate and can handle relatively high acoustic power without breakdown. Its stability is considerably high and hence it is in great demand for ultrasonic transducers in underwater applications.

Well over 1000 piezoelectric crystals have been identified due to the fact that 21 out of the 32 crystal systems are capable of exhibiting piezoelectric effect. Of these, very few find their way to the market. Polycrystalline ferroelectric ceramics such as leadzirconate titanate, lithium niobate, lithium tantalate, cadmium sulphide, zinc oxide, etc, have found their applications in less prominent areas. If lithium niobate were not so temperature-sensitive, it would have easily superseded the all-powerful quartz crystals. Even so, lithium niobate is of considerable importance for electro-optic purposes. Materials like CdS and ZnO can be evaporated or sputtered on to a suitable substrate which makes them notable amongst the other potential piezoelectric members.

The origin of the word 'piezo' is in the Greek word 'piezein' (to press). All piezoelectric materials are crystalline in structure and anisotropic in many properties such as thermal conductivity, cubical expansion and dielectric constant (non-piezoelectrics are invariably amorphous and isotropic), in addition to their unique optical properties. Piezoelectrics can be classified into pyroelectrics and ferroelectrics. Pyroelectrics generate electricity by heat. Ferroelectrics have a domain structure and show a well-defined hysteresis like ferromagnetic materials. PZT series of devices by Clevite Corporation, USA and PXE series by Mullard in the UK are the examples of ferroelectric devices.

Quartz is the most widely used piezoelectric material. Chemically, quartz is silicon dioxide (SiO_2) which crystallises in the trigonal trapezohedral structure. Quartz crystals have an axis of three-fold symmetry, i.e., the distribution of the molecules is such that rotation through 120 degrees about one of the axes brings into identical conditions and surroundings. Quartz melts at 1750°C. Large single crystals are found in nature, principally in Brazil. Due to the extensive research during the 1950s, large synthetic crystals of high purity can now be grown by the hydrothermal process which has replaced almost all natural crystal slots.

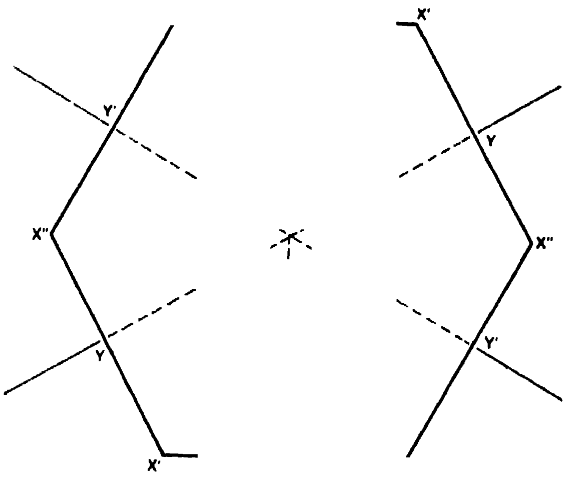
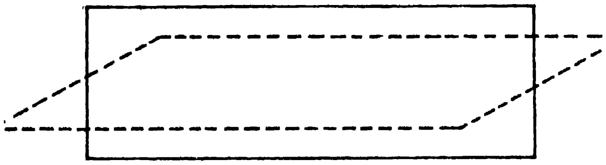


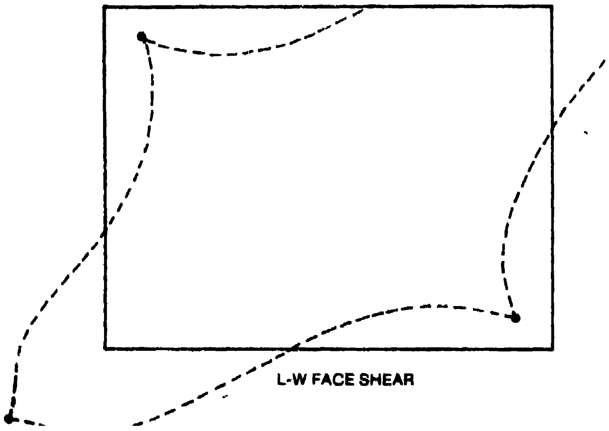
Fig. 2: Axes of natural quartz (z axis perpendicular to the plane).

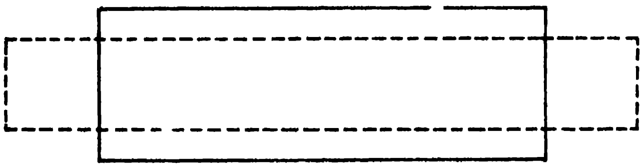
Natural and cultured quartz wafering is done using modern slurry saws and the crystal cuts are precisely oriented with respect to the three crystallographic axes. Tolerances in the planes are held much below two minutes of an arc. Wafers typically range from over 2 mm to 0.1 mm of thickness. Crystals are dimensioned to a wide variety of specifications by employing surface grinders, blanchard grinders and rounding equipments. Flatness and parallelism are achieved with the help of double-sided planetary lapping machines. These have a tolerance of ±10 millionth of a centimetre. Surface finishes range from 1 to 40 microns. Crystals with tighter angle specifications are manually X-rayed on a pendulum diffractometer. Tolerance in this final production step ranges from ±5 minutes to +10 seconds of an arc.

Modes of mechanical motion

The physical dimensions of the crystal give rise to four different modes of mechanical motions in quartz crystals. They are, thickness shear, face shear, extensional mode and flexure mode (Fig. 3). Shear stress has a turning effect owing to the formation of a couple with a definite force. The crystal does not collapse in this strained equilibrium position due to the balancing effect of the opposing couple inside the material provided, the elastic limit is not exceeded. (It is appropriate to recall the popularity of the quartz fibres here. Quartz fibres are very fine but strong and have high precision elastic properties. The celebrated experiment to measure the universal gravitational constant by Cavendish in 1798 was reformed by C.V. Boys in 1895 by using the quartz fibre as suspension medium for the pendulum. Dr F. Dolezalek used quartz fibres in the construction of the quadrant electrometer. The only alternative ever developed to this approach is phosphor-bronze strips).


THICKNESS SHEAR


L-W FACE SHEAR


EXTENSIONAL

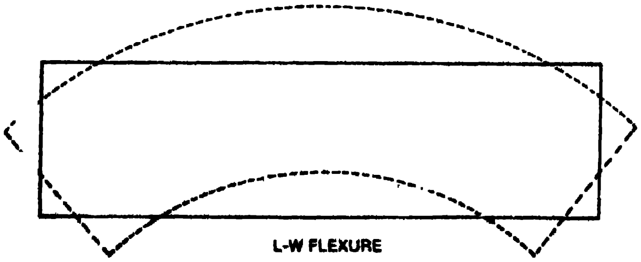

L-W FLEXURE

Fig. 3: Modes of vibrations.

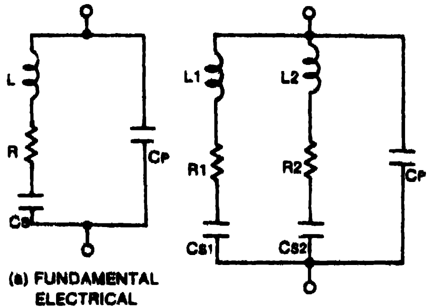
Shear force can introduce deformations in thickness and facial symmetry. The extensional mode arises due to the longitudinal expansion and contraction of the crystal structure. In flexure mode, the crystal vibrates as if it is a stretched string plucked at the centre and released.

In all these modes, the frequency stability is directly related to the amplitude of vibration of the crystal. The frequency stability nosedives with the increase in amplitude. The current passing through the crystal, therefore, has to be carefully controlled to restrict the amplitude of oscillation. Electronic technicians often call these crystals "elephants who do not forget any deed meted out to them in their life span."

An excess crystal current, even of the order of 0.01 per cent than its ratings, will upset its characteristics and this may introduce a chronic state where deviations may continue even after the excess is withdrawn. Worse still, the nature of deviation is largely unpredictable. On an average, the crystal takes few hours to retrace its original frame and sometimes may stretch beyond a few days.

Quartz as a capacitor

The electromechanical behaviour of the quartz crystal can now be summarised in another way. For a driving frequency less than the mechanical resonant frequency, the crystal behaves like a pure capacitor. At the mechanical resonance, its capacitance becomes infinitely large. At a frequency greater than the mechanical resonance, the crystal behaves like an inductor. This is what the electrical analogue of the crystal projects, as given in Fig. 4. In fact, the constituent



(a) FUNDAMENTAL ELECTRICAL

(b) OVER TONES

Fig. 4: Analogues of crystal. (a) Fundamental electrical. (b) Overtones.

elements represent the equivalents of mechanical parameters. A series combination of inductance, resistance and capacitance is representative of their mechanical counterparts such as mass, mechanical friction and crystal elasticity, respectively. The capacitance across this series chain is the distributed capacitance and is much higher than the series capacitance, Cs. Typically, Cs = 0.01pF, Cp = 1pF, L = 0.1 to 1 henry and R varies from 100 ohms to 100k. Consequently, the inductive time constant L/R is always much higher than the capacitive time constant CsR.

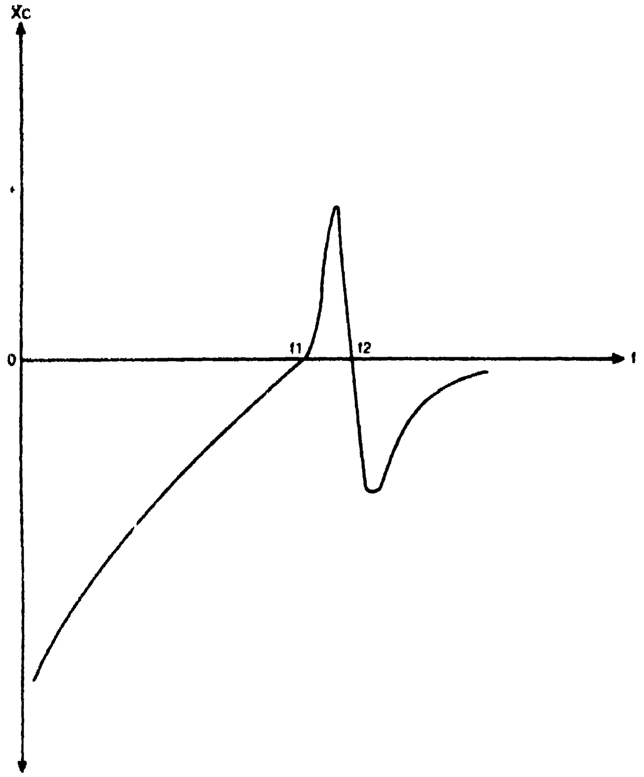
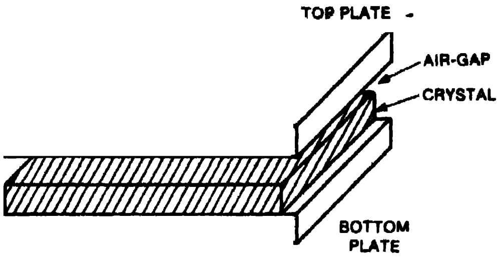
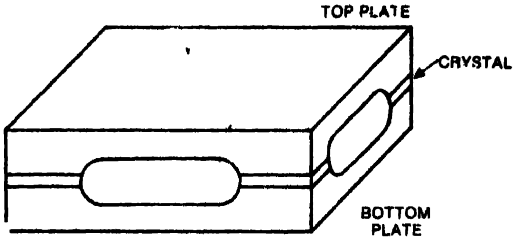


Fig. 5: Variations in crystal impedance with f.

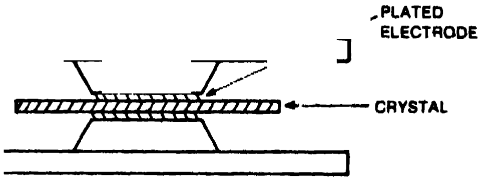
The parallel capacitance, Cp, also has a say in the frequency of oscillation of the quartz crystals though it is formed by the electrodes with quartz as the dielectric. It also includes the shunt capacitance of the crystal holder. The resonant frequency formed by Cp is slightly higher than the frequency due to the series capacitance. This frequency is known as the anti-resonant frequency of the crystal. Conversely, the series resonant frequency (where the reactance of the series arm nullifies the reactance of the distributed capacitance, Cp) nests slightly below the anti-resonant frequency. Corresponding resistive and reactive components and their variations at the resonant frequencies are presented graphically in Fig. 5.



AIR-GAP MOUNTING

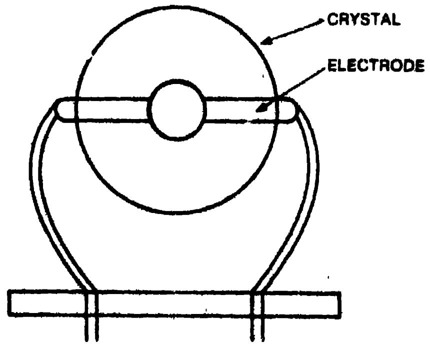


PRESSURE AIR-GAP MOUNTING



PRESSURE MOUNTING

SOLDER LEAD MOUNTING



CEMENTED LEAD MOUNTING

Fig. 6: Types of crystal mounting.

Types of crystal mounting

Most commonly used crystal mountings are air-gap mounting, pressure mounting, solder lead type mounting and cement lead type mounting. Air-gap mounting is used in low frequency applications, preferably for A and B cut crystals. Pressure air-gap mounting is employed when the crystal length is much larger than its thickness as an alternative to simple air-gap mounting. Crystals operating in flexure, face shear and extensional modes prefer to have solder lead type mounting while the simple pressure mounting is adopted in extensional mode of operation. In these cases, electrodes are plated directly on the crystal faces and the leads are vacuum deposited. The additional weights included by the solder on the crystal will be helpful in fine tuning of their mechanical resonances. For ultra-high frequency shear mode crystals, cemented lead type mounting is more convenient. Apart from these popular approaches, there are various other techniques in vogue depending upon the specific requirements.

Crystals are placed in vacuum or any convenient inert atmosphere. Practically any inert gas can be used for this purpose. The pressure level inside the encapsulation will affect the amplitude of crystal vibration. A low pressure level is often preferred but it varies from type to type. This precondition places a number of restrictions on the metallic casing such as its tensile strength, coefficient of expansion etc. Flat high tensile strength metal casings in rectangular or circular configurations are available. Another version is the common plastic encapsulation, for extremely small size crystals, e.g., the TO-18 casing. In all these varieties, the lead length is kept as small as possible, especially in plastic encapsulation where the lead length is not more than 3 mm.

Standard crystal holders, usually designated as HCxx according to their dimensional specifications, are all hermetically sealed metallic versions. The subminiature low-frequency crystals introduced by Statek, USA, have a range of 10 to 1500 kHz. A 1MHz crystal is 48 times smaller in volume than the industry standard case HC33. The physical dimension of this subminiature crystal is only 6.99 × 2.74 mm. Crystals for wrist watches are mostly in cylindrical form, varying in diameter from 2 to 4 mm and in length from 5 to 8 mm.

Overtones

The electrical analogue shown in Fig. 4 is only an approximation with the least error and is valid at the vicinity of the resonance. There are, in fact, a few more resonances in the crystal. Hence, the arms of the series in the crystal appear to have some features identical to one another in terms of their basic structures. There exist a minimum of three or more odd mechanical overtones of the crystal's fundamental frequency. (Basically all the mechanical and electrical oscillations of fundamental frequency are accompanied by overtones. These are higher modes of vibrations which are, as a rule, harmonics of the fundamental mode. However, overtones produced by musical instruments need not necessarily be exact harmonics. Depending upon the mode of vibration, the first overtone may be the third or the second harmonics.)

Fundamental crystal parameters are indeed different from that of the overtones and large enough to have an effective isolation. Third, fifth, and seventh overtones have distinct characteristics and are extremely useful at higher frequency operations.

The series resistance of the crystal analogue has the vital and pervasive role in the crystal frequency of furnishing impedance and Q of the crystal. The equivalent series resistance decreases with increase in the crystal frequency. Typically, it varies from 450 ohms to 20 ohms corresponding to a frequency variation of 1 MHz to 30 MHz. The unusually large Q factor of the crystal which accounts for its frequency stability is directly related to the series resistance. An extremely large Q factor is indicative of the very low rate of energy dissipation in the crystal. In practical cases, it varies from 10,000 to 100,000.

It is often necessary to express the degree to which the mechanical resonance is coupled to the chain of distributed reactive elements of the crystal in an electrical circuit. This is termed as the electromechanical coupling ratio of the crystal unit. A fairly accurate expression of electromechanical coupling of the crystal evolves from the ratio Cp/Cs itself. Thus an enormously large ratio is possible if Cs is negligible. In the poorest of cases, Cp may decrease to a minimum due to the dielectric effect of quartz, thus diminishing the holder and external shunt capacitance. It is important to keep this ratio above 100, below which the resonance characteristics will deviate seriously. (The electromechanical coupling ratio or coupling coefficient is defined as the ratio of the mutual energy to the square root of the product of the primary and secondary energies. It can also be a measure of how much of the energy supplied in one form, such as electrical or mechanical, is stored in the other form.)

Fabrication techniques

Making application-specific crystals more attractive and easier to deal with is the use of new tools and computer-aided fabrication techniques whose developments have been hastened by the advances in computer technology. As a result, extremely high precision in crystal cuts and orientation angle is now possible. A brief schematic, in terms of the orientation angle, cuts and application is presented in Fig. 7.

The most commonly used cuts are AT and BT cuts which are also known as the rotated Y cuts. These are obtained by rotating the plane perpendicular to the Y axis (Y plane about the X axis). These are the kindest cuts in the world without drift. Zero temperature coefficient over a wide range is the key attraction of these two cuts. Thickness vibrations and their overtones exist for each individual mode, viz, A, B and C. Mode A is essentially the thickness extensional mode while B and C are thickness shear modes. The frequencies for each mode always follow in the sequence of increasing time period, i.e., Ta > Tb > Tc.

The frequency-temperature behaviour of the various quartz cuts is determined by taking into consideration the

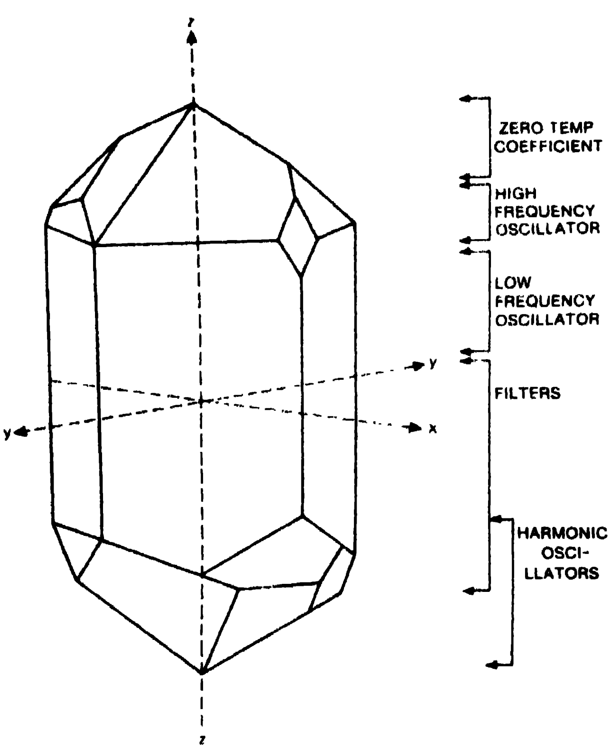


Fig. 7: Schematic showing the orientation angle, cuts and applications of crystals.

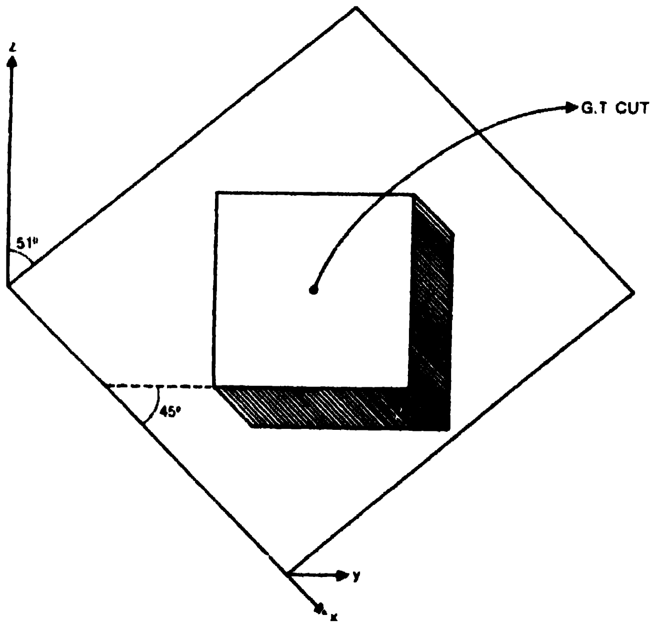


Fig. 8: Orientation of G.T. Cut.

higher order temperature coefficients of a power series. Mode A, basically a longitudinal mode, has a negative temperature coefficient of frequency for all orientations but at certain orientations (e.g., 35^0 21') it reaches the minimum. Shear mode B has a first order zero temperature coefficient of frequency for orientations 0^0 to 13^0, both on the negative side. The shear mode C has zero temperature coefficient of frequency for orientations 0^0 to 30^0 at both positive and negative angles.

Various types of crystal cuts are used in specific applications. A brief review is given in Table I. The temperature coefficient is measured by the frequency change divided by the centre frequency per degree celsius variation in temperature. This factor varies according to the crystal cuts. The frequency may either increase or decrease with an increase in temperature for a particular cut depending on the absolute value of temperature. The frequency temperature characteristics of each crystal cut will approach zero at a particular temperature. Conversely, the temperature coefficient can approach zero value at a given temperature by changing the nature of the element and its orientation angle. The deviations above this critical temperature are taken as negative.

TABLE I

Temperature stability of crystals cuts

Standard element	Standard cut	Mode of vibration	Temperature stability ppm per deg. celsius
A	AT	Thickness shear	- 0.05 for 35^0 21^3 + 0.80 for 35^0 13^8
B	BT	Thickness shear	±4.4
C	CT	Face shear	± 3.5
D	DT	Face shear	± 2.0
E	+ 5^0X	Extensional	- 7.0
F	- 18^0X	Extensional	—
G	GT	Extensional	—
H	+ 5^0X	l-w flexure	—
J	Duplex	l-t flexure	- 3.5
M	MT	Extensional	—
N	NT	l-w flexure	± 2.5

Crystal vibrations

Amplitude of mechanical vibration of the crystal influences the frequency stability, irrespective of the crystal cuts. The higher the amplitude of vibration, the poorer the frequency stability. So here we have an evident area for improvement, though little can be done with the rest of the parameters. The amplitude is directly proportional to the

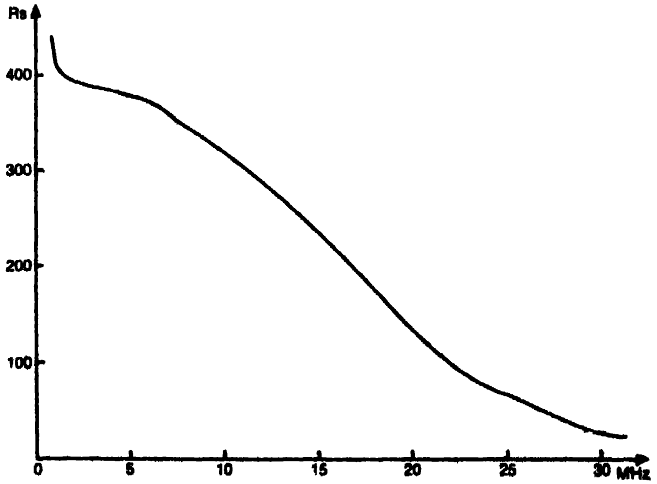


Fig. 9: Variation of Rs with resonant frequency.

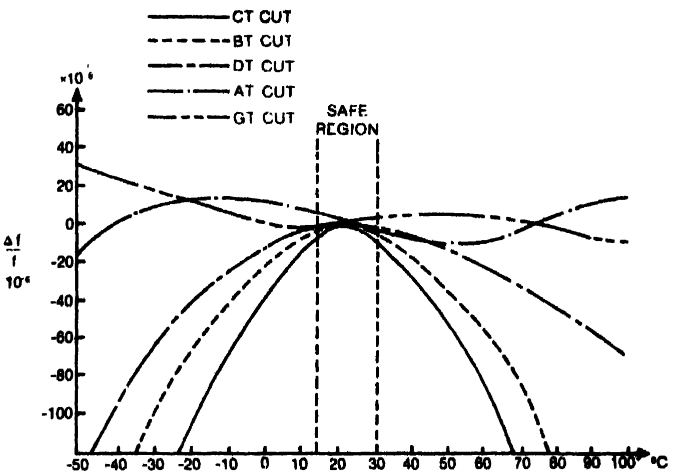


Fig. 10: Graph showing frequency deviation with temperature.

current through the crystal which means the crystal oscillators are most reliable at the minimum safe-operating current. According to present standards the fractional drift of a crystal oscillator is less than 10^{-10} Hz per day and the temperature sensitivity is less than 10^{-11} Hz per degree Celsius within the prescribed level of supply voltage. This is virtually insignificant compared to the average frequency drift of an RC or LC oscillator. The estimated RC is approximately 6×10^{4} Hz per day while that of an LC oscillator is 72×10^{-4} Hz per day. However, RC oscillators are absolutely unreliable beyond a frequency of 2 MHz. A brief comparison of RC, LC and crystal sections is given in Table II.

TABLE II

Frequency stability of basic sources**

Oscillator type	Frequency range MHz	Fractional drift per day	Thermal drift per deg. C
RC oscr	2	6×10^{-4}	5×10^{-5}
LC oscr (fund)	65	7×10^{-3}	5×10^{-5}
LC oscr (harmonics)	512	2×10^{-3}	4×10^{-5}
Crystal oscr (fund)	22	1×10^{-10}	1×10^{-11}
Cesium atomic	5	4.5×10^{-15}	

**Figures are approximate indicators.

There are various methods for desensitising the crystal oscillators from the temperature variations. One of them is to use a series reactance in the crystal circuit whose temperature coefficient cancels the temperature coefficient of the crystal. Another method commonly practised is the use of a voltage variable capacitor with a temperature-dependent bias such as a thermistor. A typical circuit employing this approach is given in Fig. 11.

For an extremely high degree of stability, thermostatically controlled ovens are used. Double ovens or an oven within an oven are not uncommon. When the oven temperature coincides with the critical temperature of the crystal, a near-zero temperature coefficient is achieved. In high precision applications, a suitable combination of above-mentioned methods is used. Finally, in any application, the proper choice of crystal cutting angle will decide the temperature coefficient of the crystal.

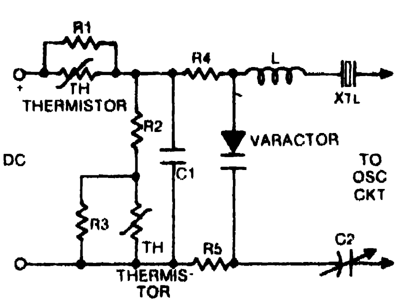


Fig. 11: Temperature compensation circuit.

The predominant factors of the clock or signal source are accounted not only by its precision in frequency in short and long run, but by several other factors also, such as duty cycle or mark-space ratio, impedance of the source, stability of the amplitude with respect to frequency and load, the range of frequency and so on. There is practically no such clock which satisfies all these requirements. Nevertheless, all these specifications are not inevitable for all the applications.

Deterministic fluctuations

Fluctuations in frequency due to ageing, deviations in ambient temperature and supply voltage, humidity variations, vibrations, etc are often referred to as 'deterministic' fluctuations, which are the major contributers to the short term stability. Short-term frequency stability is generally not an important consideration in RC oscillators and LC circuits. Fortunately, crystals can offer a very high degree of short-term stability merely by careful selection and mounting. However, long-term stability (nondeterministic), governed by random variations and shot and thermal noise is not fully covered in crystal oscillators. (Frequency of domestic supply has better stability in this respect.) The measures taken to ensure the long-term stability in crystals are broadly classified into two sections. One is to use special circuits for suppressing spurious modes of oscillations, especially in overtone crystals. The other method is related to crystal mounting and encapsulation.

Crystal—the undisputed leader

The crystal is the undisputed leader of signal and clock generators. Now it is moving on to an important, in some cases, dominant position in standard chips like memories, microprocessors and random logic. There are several reasons to support this move such as increase in precision, reliability and mean time between failures of the crystal based devices. It also removes the need for drift elimination or trimming, leading to an acute reduction in maintenance expenditure. With this, it is easy to incorporate diagnostic support for self-testing and remote-diagnosis in not-so-easily accessible devices.

Basically, any LC oscillator can be crystal controlled. The crystal can be used to set the frequency of operation with an adjustable LC or RC circuit used to trim the oscillator output to an exact frequency. The most popular formation is the Pierce oscillator, though Hartley, Colpitts and harmonic or overtone oscillators are equally favourable.

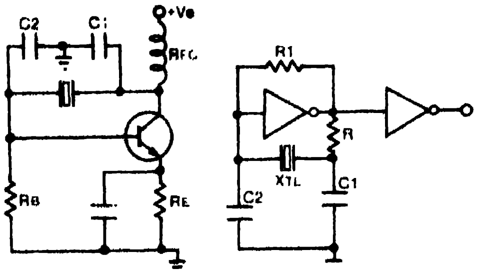


Fig. 12: The Pierce oscillator. (a) With transister. (b) With gate.

In a Pierce oscillator, no LC circuits are required for frequency control. Instead, the frequency is set by the crystal (Fig. 12(a) and (b)). At frequencies below 2 MHz, a capacitive voltage divider may be required across the crystal. The connection between the voltage-divider capacitors must be grounded so that the voltage developed across the capacitors is 180° phase-inverted. Moreover, like many other oscillators, these can also be set by single gate, transistor or op-amp configuration and the losses in the crystal be controlled by simple resistors. (Crystals reduce oscillator efficiency as a result of losses in the crystal which is represented by their series resistance. Oscillator efficiency may be increased by reducing signal currents in all dissipative elements.)

Minute trimmings and adjustments can make a big difference in the frequency of oscillation of the crystal circuits and drift and production tolerances can be effectively checked. A typical configuration is shown in Fig. 13. Frequency adjustments can be made with a variable inductor or capacitor in series with the crystal which provides a means for frequency tuning too. The lower limit of frequency is set by the inductor in series with the crystal. However, a reduced Q and an associated instability can be anticipated at lower frequencies.

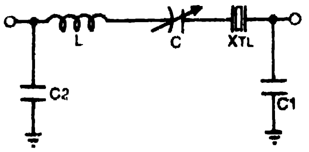


Fig. 13: Frequency correction circuit.

Crystal oscillator

The low frequency crystal oscillator shown in Fig. 14 uses capacitor C2 in series with the crystal for fine adjustments. The oscillator frequency increases with decrease in the series capacitance. The crystal is placed in the feedback circuit between the emitters of the two transistors and operated in the series mode. Another example of the series oscillator using inverter gates is given in Fig. 15.

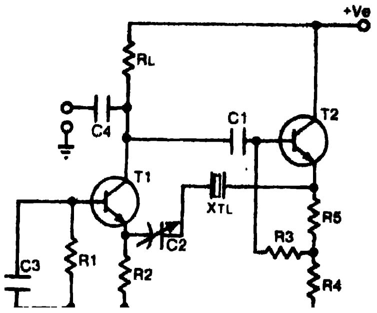


Fig. 14: Low frequency oscillator.

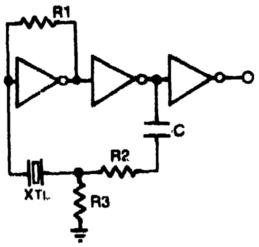


Fig. 15: Series oscillator.

The practical limit of the fundamental resonance is around 33 MHz. Higher order frequencies are derived by overtone operations or multipliers. From 20 to 60 MHz, third overtone crystals are used. Between 60 and 120 MHz, fifth overtones are used and above 120 MHz seventh overtones are preferred. Beyond 200 MHz, overtone operation is almost ineffective, leaving the task to frequency multipliers.

In general, high frequency generation is not easy. It requires more critical adjustments to arrest the tendency of the circuit to oscillate at the lower overtones or frequencies. Specially designed filters and frequency selectors are pressed into use in the circuits of high frequency generation, primarily to avoid the overlapping of the frequencies.

A tuned LC circuit is a part of the overtone oscillators. The reactive elements of the LC circuit and crystal form a coupling network between the amplifier output and input producing the necessary phase shift. The crystal introduces an additional reactive element making extremely large phase shift changes for a very small frequency change. The inherent reduction in the efficiency is a foregone conclusion. An approximate picture of the power relationships between the fundamental frequency of the crystal and its overtones and harmonics is drawn in Table III. Extraction of harmonics from the overtones is rarely practised. Another critical area is the close proximity of the fifth and seventh power

TABLE III

Power relationship between overtone and harmonics

R.F. power output as a percentage of DC power input				
Crystal freq.	**Fund**	**2nd harmonics**	**3rd harmonics**	**4th harmonics**
Fundamental	32	15	10	5
3rd overtone	25	15	10	5
5th overtone	20	12	7	3
7th overtone	20	12	7	3

relationships.

With all the microcomputers, microprocessors, digital clocks and watches available today, it is surprising that time-keeping and signal clock generation is often so meticulous an affair. The fact is that the required circuitry is already incorporated in the IC, so that very few external components are called for. The design problem is also made easier by the fact that no timing fluctuations are involved as long as IC types are selected for the right speed to cope with the application in hand. To take care of the relative aspects of the price index, the present day ICs have included the provision for RC or LC timing networks in place of expensive crystals.

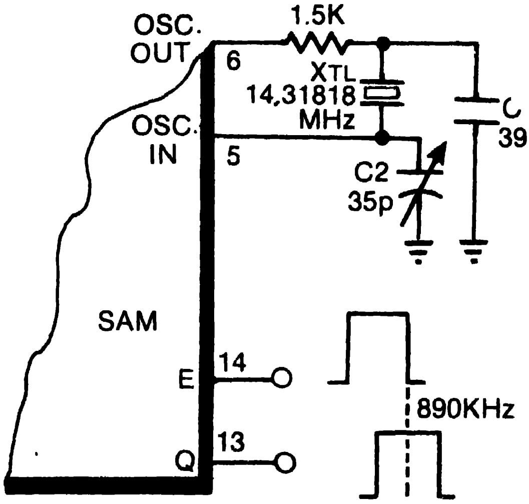


Fig. 16: TRS-80 colour computer clock.

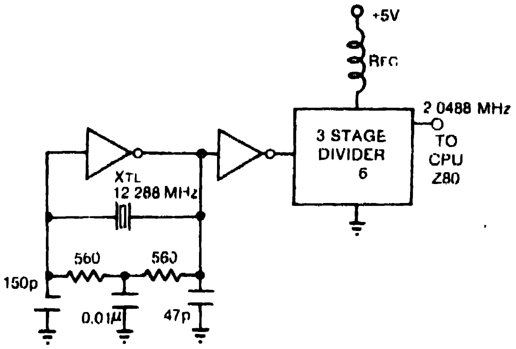


Fig. 17: H-89A system clock

Majority of the microprocessor or MPU crystal oscillator sections are designed to interface with an AT cut crystal, operated in a suitable mode in the frequency range specified for the crystal. The crystal should be mounted as close as possible to the input pins to minimise the output distortion and start-up time. The start-up stabilisation time plays an important role in the operation of the microprocessors. The built-in 'power on' circuitry provides a definite delay from the time of the first oscillator pulse. If the external reset pin is low at the end of the set time delay, the processor remains in the reset condition.

MPU crystals are treated as special brands and marked by their low series resistance, tight frequency setting, stable frequency tolerance and excellent long-term stability. Reliability is assured by the use of MIL-approved manufacturing processes. All the MPU or processor crystals feature low start-up resistance. MPU crystals are used in baud rate generators, bit rate generators and dual baud rate generators. MIL specifications related to the QPL crystals are MIL-0-55310, MIL-C-45662A, MIL-I-45208A, MIL-Q-9858A, MIL-C-3098F and MIL-F-18327. These standards define prerequisites to cope with humidity, vibration, shock and radiation effects.

(To be continued)

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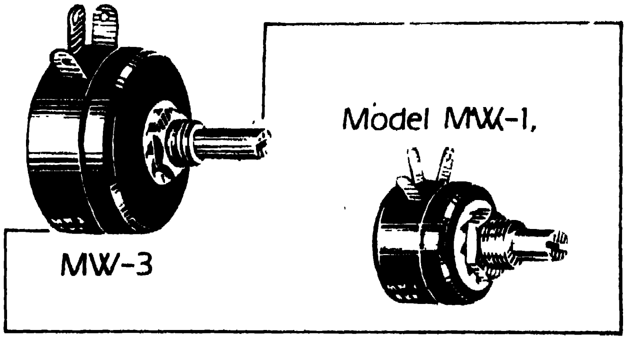
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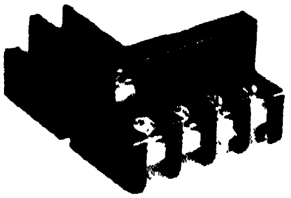

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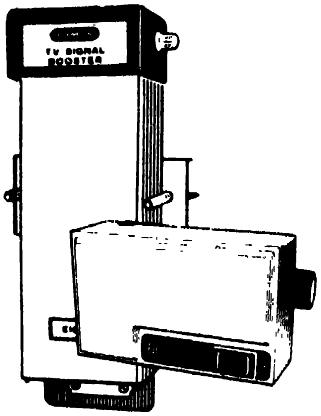

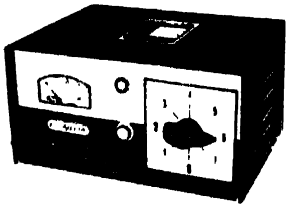

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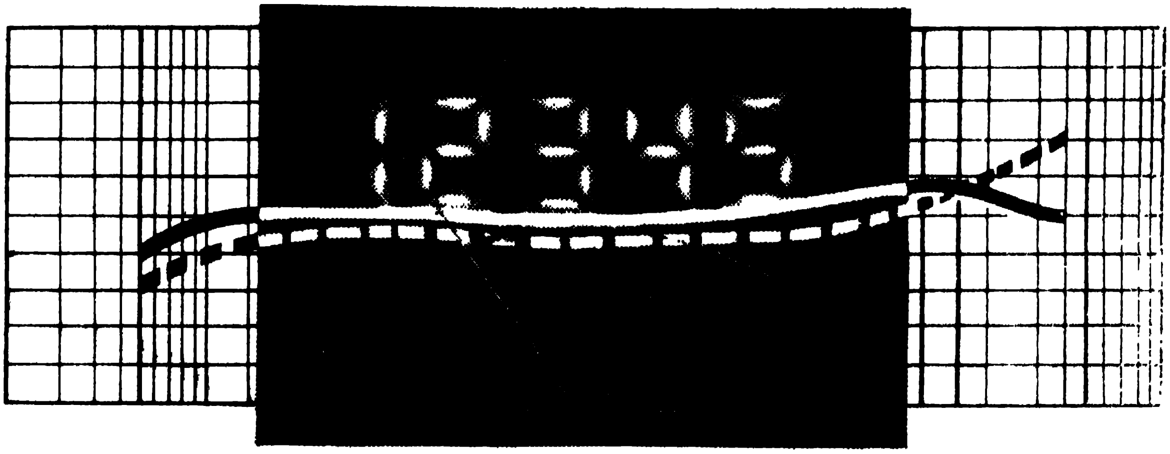

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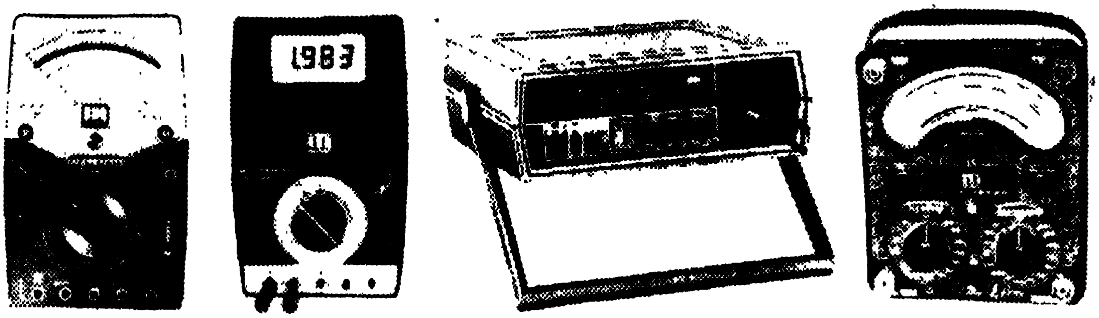

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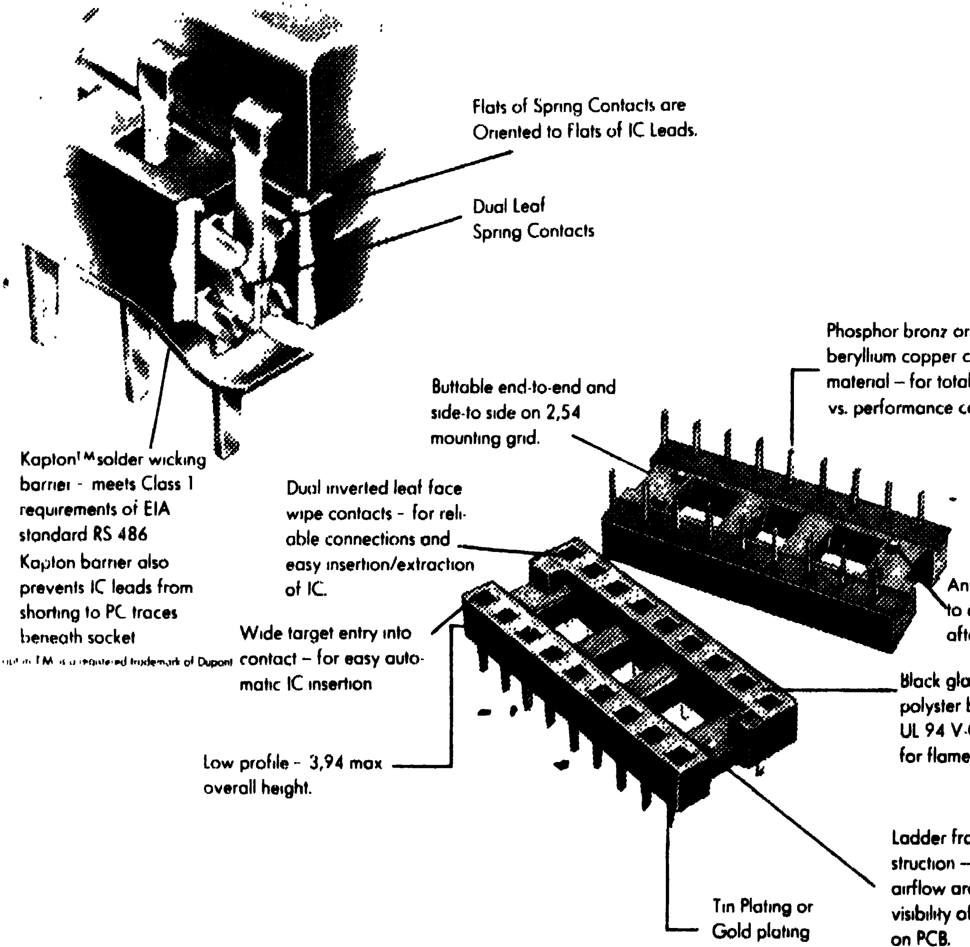
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Crossover Networks

Jasvinder Osan

Crossover networks are used in multi-way speaker systems to split the input signal into separate frequency bands to be fed into special-purpose speakers designed to cover a specific range of frequencies. Special-purpose, or hi-fi speakers as they are sometimes called, are commonly known as woofers, squawkers or midrange, and tweeters, to signify the range of frequencies which they cover.

The use of crossover networks in a multi-way system becomes essential when such speakers are used so as to limit their response to be in the range of frequencies within which their response is smoothest. A woofer, for instance, designed to cover only the low frequencies has its response 'rolled off' in the mid or upper mid frequency region so as to allow another speaker a squawker or a tweeter to take over.

The use of specialised speakers for different frequency ranges is also essential as it is difficult to have a single speaker to cover the full audio frequency range satisfactorily. A speaker which covers a wide frequency range is known as a fullrange. The response of a fullrange is, however, peaky and is subject to greater harmonic distortion than a multi-way speaker system utilising special-purpose speakers with a well designed dividing network to give a smoother and wider response.

However, if the crossover system is ill-designed or not made properly, it would ruin the overall performance of the speaker system rather than improve it, regardless of the enclosure design and the quality of the loudspeakers used. It is obvious therefore that a crossover network forms a critical part of a speaker system

Crossover systems may be either of the active type or the passive type, utilising a combination of inductances and/or capacitances to form low pass, high pass or even band pass elements. We shall be concerned only with the passive type of crossover networks as these are the most commonly used. The two basic rules for designing a crossover network are:

1. The loudspeakers should have a usable response extending to above the tentative crossover point and all the loudspeakers should have similar sensitivities in this region.
2. The crossover network design should be as simple as possible.

In a two-way speaker system which comprises a woofer and a tweeter, a two-way corssover is used. This basically comprises a low pass and a high pass section and is most often connected in parallel as shown in Fig. 1. The circuit shown in Fig. 2 is similar to Fig. 1 but has two elements in each section. The two circuits differ in their attenuation rates. The first circuit has an attenuation rate of 6 dB/octave while the second has an attenuation rate of 12 dB/octave on account of the additional filter elements used. The attenuation rate gives us the rate at which the response of the filter rolls off. Greater the attenuation rate of a filter, sharper the cutoff. Fig. 3 shows another two-way circuit with an even larger number of filter elements and having an attenuation of 18 dB/octave. The attenuation rate increases as the number of reactive elements in a section is increased.

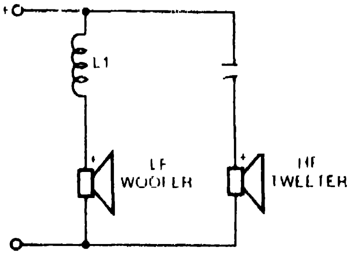


Fig. 1: 6dB/octave, 2-way crossover network.

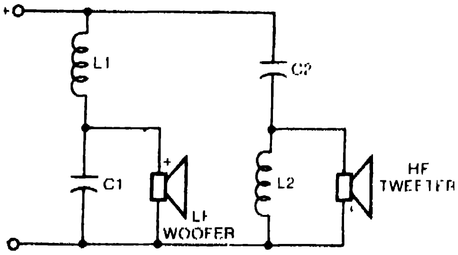


Fig. 2: 12dB/octave, 2-way crossover network.

In hi-fi systems, either 6dB/octave or 12dB/octave filters are used. Some designs utilise a combination of 6dB and 12dB/octave sections. Such arrangements are known as asymmetric filters. Attenuation rates above 12dB/octave

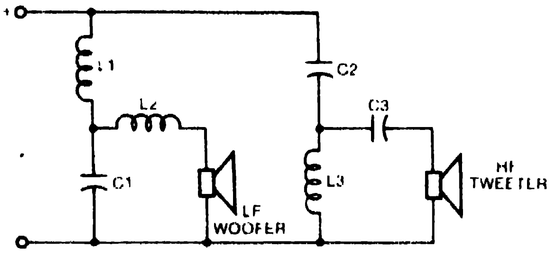


Fig. 3: 18dB/octave, 2-way crossover network.

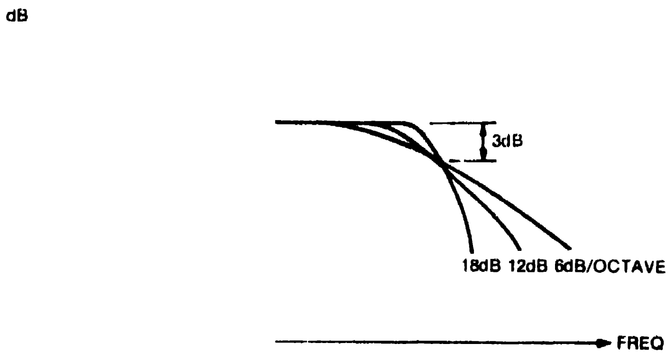


Fig. 4: Comparison of 6dB, 12dB, and 18dB/octave rolloff rates.

are rarely used as besides making the filter very complicated, a very fast roll off rate can very often introduce transient problems in many speakers. A 12dB/octave filter is the one most commonly recommended for use in hi-fi systems on the ground that a 6dB/octave filter is 'very slow' and not suitable for hi-fi systems. Paradoxically, in many cases (which shall be dealt with later), a slow action filter can be made to give better results than the fast acting one through a careful study of the speaker response and desired crossover frequency.

Mathematical representation

The capacitance and inductance values can be determined from the following formulae, for a given crossover frequency and loudspeaker impedance!

$$C = \frac{1}{2\pi f_0 Z} \qquad \ldots. 1.$$

$$L = \frac{Z}{2\pi f_0} \qquad \ldots. 2.$$

where Z is effective impedance of the speaker, f_0 is the crossover frequency, L is inductance in milli henry, C is capacitance in micro farad.

This gives the reactance values for a 6dB/octave filter. In case of filters having two reactive elements per section as in the 12dB/octave filter, the reactance value of the elements is $\sqrt{2}$ times the effective impedance Z of the loudspeaker. This means that in a 12dB/octave filter, both inductances and capacitances have the same value. These results and formulae are applicable to the parallel circuits shown in Fig. 1 for the 6dB/octave filter and Fig. 2 for the 12dB/octave filter for two-way systems.

These results can be extended to a three-way corssover system which is utilised when a three-way speaker system comprising a woofer, a squawker and a tweeter is used. The mid-range of frequencies forms a band between the lows and highs and logically requires a bandpass arrangement to function in the filter. The bandpass is designed by establishing the upper and lower frequencies of the bandpass filter and using a series combination of a low pass filter formed by an inductor and a high pass filter formed by a capacitor. The component values for these can be determined using the same method as described above. The circuit arrangement for a three-way crossover network of 6dB/octave and 12dB/octave types are shown in Figs. 5 and 6 respectively.

For example, in the case of a three-way system using a 6dB/octave network, first of all the value of the required series inductance is determined using equation 2 after substituting in this the frequency at which we wish to crossover to the squawker, say f_1. The inductance obtained, L1, acts as a low pass filter and blocks higher frequencies—in this case, above f_1Hz with an attenuation rate of 6dB/octave. One octave is referred to as a doubling of frequency, hence an octave above f_1Hz is twice this frequency, say, $2f_1$Hz. This theoretically implies that the signal would have undergone an attenuation of 6dB at $2f_1$Hz. Next, moving on to the mid-frequency arm of the filter, the value of capacitor C1 is determined using the lower crossover frequency, f_1Hz. Suppose we wish to roll the squawker over to the tweeter at f_2Hz, we substitute this in the relevent formula to get the required inductance L2. In the same way, the capacitor C3 may be found by applying the upper crossover frequency f_2 to form the required high pass filter for this section.

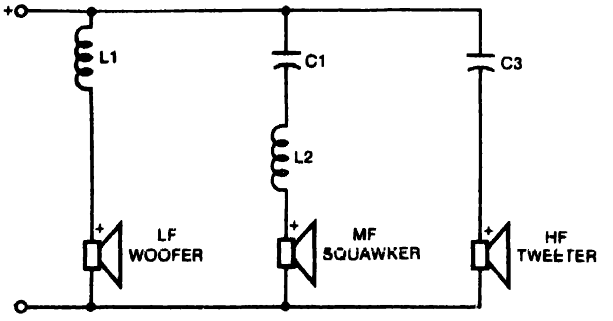


Fig. 5: 6dB/octave, 3-way crossover network.

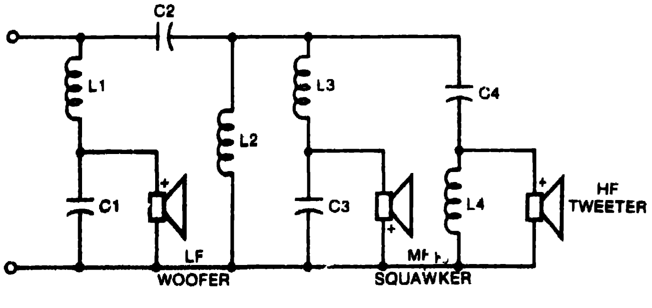


Fig. 6: 12dB/octave, 3-way crossover network.

Proceeding in the same way, the component values in the

12dB/octave network can also be found. The only difference in this case is that the reactance required from each element is now$\sqrt{2}$ times the effective impedance of the loudspeaker. Hence the reactance formula given above is divided by$\sqrt{2}$ in the case of the capacitance and multiplied by$\sqrt{2}$ in the case of inductance. It will be noted that the bandpass element values will be similar to the low pass and high pass section values, except that their order of operation is reversed i.e., C1 which forms a bypass element in the low frequency section is of the same value as C2 which forms the high pass element of the bandpass section. In the same way, the series inductor L1 is the same as the shunt inductor L2. Similarly, in the upper frequency section, the inductor L3 has the same value as L4 which shunts the tweeter. Capacitors C3 and C4 also have the same value.

The practical view point

So far, we have looked at crossover networks on a purely theoretical or ideal stand-point. That is, we have imagined a purely resistive load remaining constant over the full frequency range. Moreover, we have assumed that the loudspeakers also have an absolutely flat response. But sadly, things do not work out like this in actual practice and many a constructor finds himself landing up with outlandish results in spite of the best design efforts. In the first place, the rated impedance of a loudspeaker is anything but within a narrow range of frequencies. Fig. 7 shows the impedance versus frequency plot of a typical loudspeaker. It will be seen that the impedance is never constant and is maximum at the resonance frequency of the loudspeaker, sometimes over four times the rated value. This gives birth to the golden rule never put the crossover point anywhere near the resonant frequency of the loudspeaker!

The rated impedance of a loudspeaker is usually defined as the lowest value above resonance and is about 15 to 20 per cent higher than the DC resistance of the loudspeaker. With further increase in the frequency above resonance, the impedance increases gradually as the loudspeaker becomes more and more mass controlled. Since many a crossover point lies way above the resonance and for that matter, where the impedance was the stated value, it is important to consider the effective impedance of the loudspeaker at the crossover frequency (which is likely to be somewhat greater than the stated minimum impedance) rather than the rated impedance, for purposes of crossover network design. For practical purposes, it is enough to assume an effective impedance

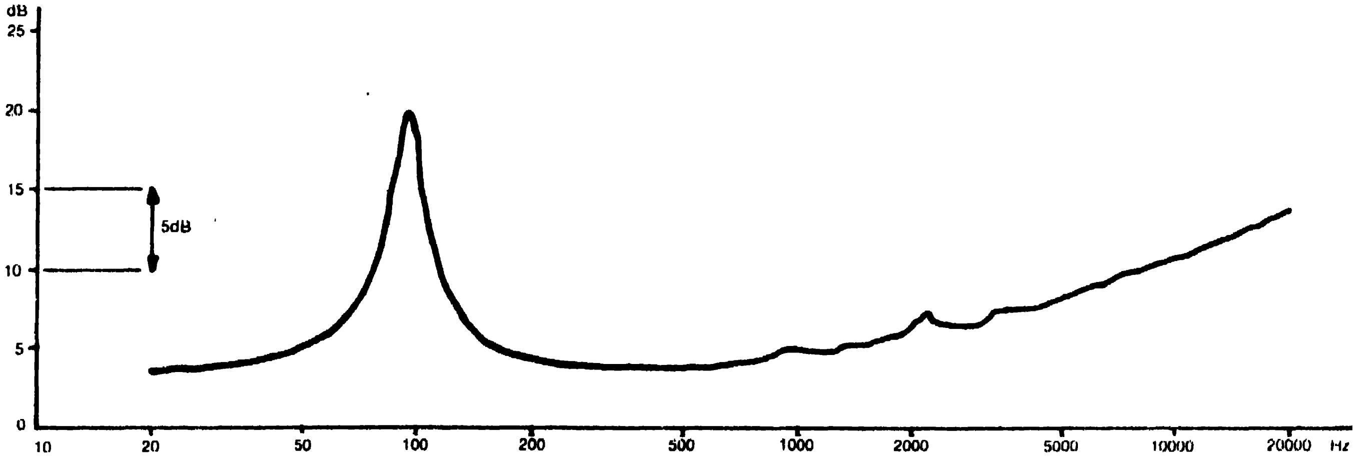


Fig. 7: Impedance curve of a typical loudspeakers.

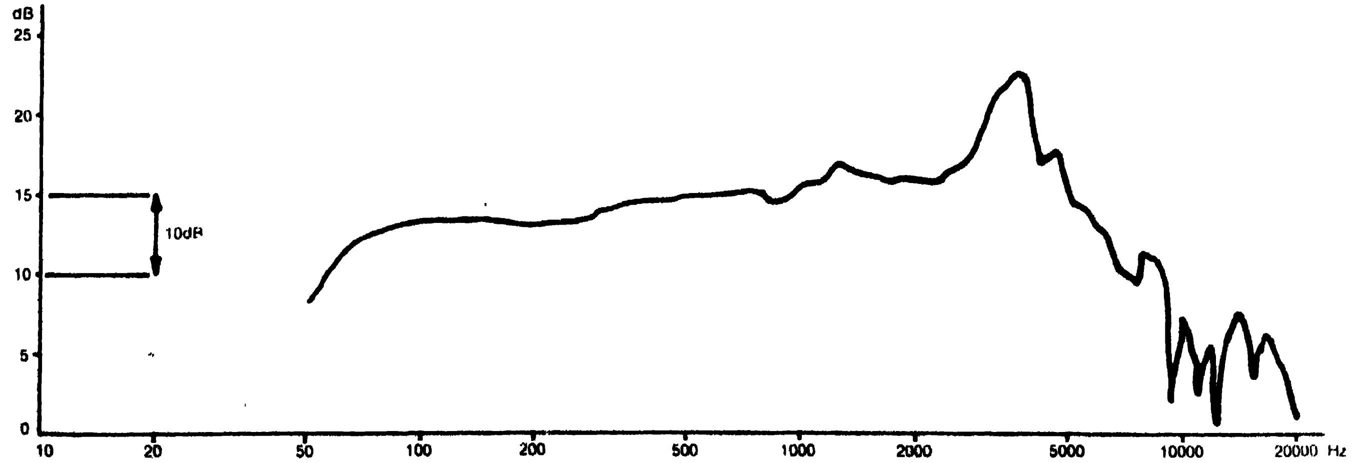


Fig. 8: Frequency curve of a 20 cm woofer mounted in a 20-litre sealed enclosure.

of 5 ohms when the rated loudspeaker impedance is 4 ohms; 10 ohms when the rated impedance of the loudspeaker is 8 ohms; and so on.

One important factor which dictates the choice of crossover frequency and effects the performance of the system to a great extent is the frequency response ranges of the component loudspeakers. Many manufacturers of loudspeakers are notorious for not releasing any response curves and thereby making things pretty difficult for the crossover designer. The reason why it is so important to have some idea of the frequency response of a loudspeaker when designing a crossover network is very obvious since we want a speaker to function upto a certain crossover point, it should have an acceptably smooth response at least up to that point. Rest assured, even the better loudspeaker will have a response curve which vaguely resembles a mountain range. Many manufacturers state the frequency range of the speaker, though the variation in terms of decibels (dB) may not be stated. From this the designer can know, to some extent, the response ranges of the speakers. The frequency ranges of all the speakers should be overlapping so as to be compatible for use in a multi-way system. Also, when selecting the crossover point, the speaker manufacturer's recommendations should be taken into consideration, as it is essential for the sensitivities of the speakers to be equal at the crossover frequency. If this is not so, a step will appear in the overall frequency response of the system which will indicate a sudden drop in the output due to a speaker having a lower sensitivity.

Simpler, the better

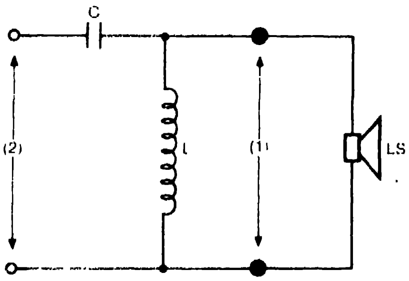
Very often, the crossover network can be simplified and at the same time made more effective by incorporating the basic response characteristics in the crossover design. For example, woofers generally have high inductance voice coils as part of their design to achieve a high energy product and power handling capacity. This inductance can be incorporated in the crossover network as part of the low pass filter, thereby reducing the size of the component and at the same time maintaining the constant resistance behaviour of the network. The cone texture of many woofers is also not conducive to mid and high-freqency output and helps in rapidly rolling off the highs, acting as a built-in corssover network. For this reason, it may not be always necessary to employ a very high cutoff rate in the low-frequency section of the filter, unless a very low crossover frequency is aimed at.

In general, if the lower crossover frequency is above 1 kHz, a 6dB octave filter in this section is quite sufficient, whereas if the crossover frequency is below 1 kHz, then a crossover rate of 12dB octave should be employed. In the same way, in the case of tweeters, if the crossover frequency is very high, say, above 6000 Hz, a 6dB octave filter will be quite adequate, but if we intend to operate the tweeter below 4000 Hz, a 12dB octave filter is a must because a slower acting filter passes through some lower frequency energy regions which could destroy the tweeter, besides introducing a good deal of distortion. In the case of mid-range speakers viz., squawkers, the bandpass section can sometimes be left out altogether, using instead a simple high pass filter and letting the natural response of the speaker do the rest. The ear, in fact, is the best judge and it is advisable to initially mount the crossover outside the enclosure and listen to the system. Changes can then be made as necessary before final assembly.

TABLE I

Power handling capacity measured as per DIN 45573/IEC 268-5 (See Fig. below) of Philips dome tweeter

LS Rated Impedance ohms	Frequency 3dB (kHz)	Net-work		LS PHC measured at 1 (watt)	System PHC at 2 (watt)
		CμF	L(mH)		
4	2	12	0.35	4	20
	4	5	0 20	6	50
8	2	8	0.20	4	20
	4	3.2	0.35	6	50



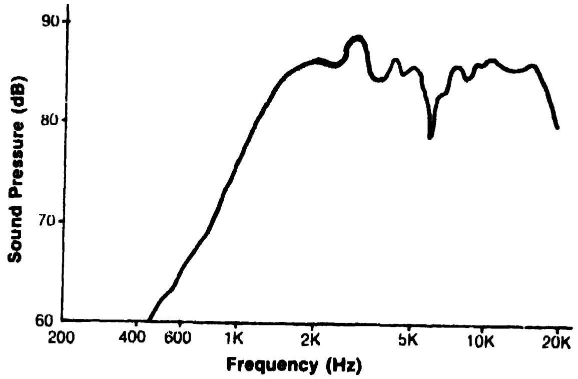


Fig. 9: Frequency curve of a Philips dome tweeter.

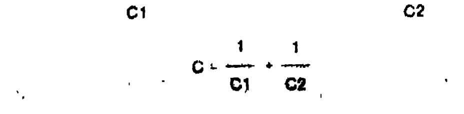
One final point which deserves some mention is that of the power handling capacity of all the loudspeakers which are to be used in a multi-way speaker system. Where the power handling capacity of the woofer is usually high and can be assumed to be handling most of the input power, the power capacities of the other speakers, in particular tweeters, is usually very low and requires prior attention while designing the network to ensure that the tweeter is not overloaded in the system. Tweeter coils are very light and usually wound with very fine gauge wire and can withstand at the most a couple of watts across the terminals. Of course, the high pass filter limits the amount of power input, but this depends on the crossover frequency. The lower the crossover frequency, the greater the energy transmitted across the filter, and hence lower the power the tweeter can handle in the system. In the event of tweeter power capacity falling short, either the crossover frequency should be adjusted viz., raised higher, or two tweeters of half the required impedance should be connected in series and used.

A speaker manufacturer usually gives the power handling capacity of a tweeter or a squawker with a particular high pass filter connected to the speaker, the details of which are usually given. This should be taken into account when designing the filter. Anyone who played around with speakers would probably be aware how an expensive tweeter may go to waste when too much power is sent across the little voice coils. Incidentally, it is impossible for a repaired tweeter to sound the same as before, as the response of a tweeter is effected by little things such as the size of the solder beads and the type and amount of adhesive, amongst other things. It is proper therefore, to get it repaired only from the manufacturer.

Construction

Crossover networks are easily assembled on tag boards or even terminal strips. However, for production purposes, a printed circuit board is most convenient. In all arrangements, it is preferable to have more than one inductor, spaced away from one another. The components for use in a crossover network should be so selected as to give minimum losses in circuit. These losses are caused by the power factor of the capacitors and the small but finite resistance of the inductor coils. Obviously, a bigger and more complicated network will have more losses than a simpler one on account of greater number of components.

The power loss occuring on account of a crossover network is stated in terms of insertion loss in decibels (dB). The insertion loss becomes a very important factor in high-power systems as at high-power levels, a considerable number of watts may be dissipated in the network itself. To ensure a low insertion loss, it is advisable to use a thick copper wire (18-22 swg) for all coils and capacitors with a low-power factor. Many manufacturers utilise 'cored' coils to reduce the amount of wire used and at the same time reduce the losses. The value of the capacitance required in most crossover circuits makes it necessary for only the electrolytic type of capacitors to be used. These are, however, polarised, i.e., have a positive and a negative terminal and cannot be used as such in filter circuits.



$$C = \frac{1}{C1} + \frac{1}{C2}$$

Fig. 10: Two electrolytic capacitors connected in back to back fashion to form a non-polarised capacitor.

For this purpose, two electrolytics may be wired 'back to back' as shown in Fig. 10 to obtain a non-polar capacitor. The resultant capacitance is given by the series law for capacitance viz., $1/C1 + 1/C2 = 1/C_T$. It should be noted that in this case the positive terminals of the two capacitors are facing outwards. In this way any desired capacitance can be obtained. It should be noted that the working voltage of the capacitor should be greater than the peak output voltage of the amplifier. Otherwise, a working voltage of about 40 volts is normally suitable for almost all purposes. In the high frequency section where a large capacitance may not be required, metallised polyester capacitors serve the purpose well. These have a low power factor and a low self inductance as well, and so do not generate any high impedances at high frequencies. If required, the two capacitors may be wired in parallel to increase the capacitance. Alternatively, it is also possible to wire a polyester capacitor across two 'back to back' electrolytics in the high frequency section of the filter to counteract the inductive effect of the electrolytics at very high frequencies, allowing part of the capacitance to be contributed by the polyester type capacitor.

For the inductances, air-cored coils are the best bet for the constructor as they can be easily constructed and are, performance-wise, the best. However, the DC resistance of the coils should be kept as low as possible and the thickness gauge of enamelled copper wire (within the budget) should be used. Generally, inductances below 1 mH may be wound with 22 swg, but inductances above 3 mH should be wound with 18 swg or even thicker wires. The size of the air core required to obtain maximum inductance with the minimum wire for a given diameter of the wire d in cm is given by the following formula:

$$a^5 = \frac{Ld^4 \times 10^9}{24.5}$$

where a is the radius of the former in cm
d is the diameter of the wire in cm
L is the required inductance in henry (H)

A little calculation gives the diameter, 2a of the former to be used.

(To be continued)

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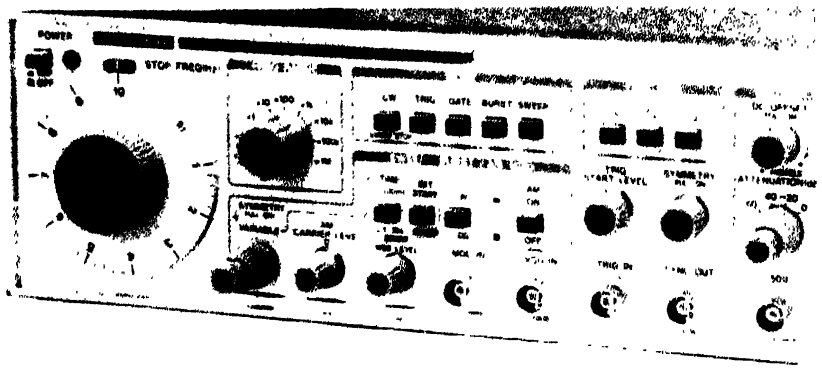

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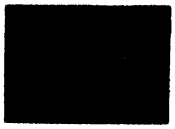

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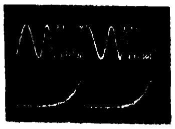

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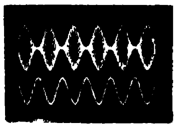

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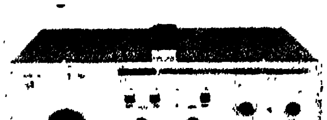

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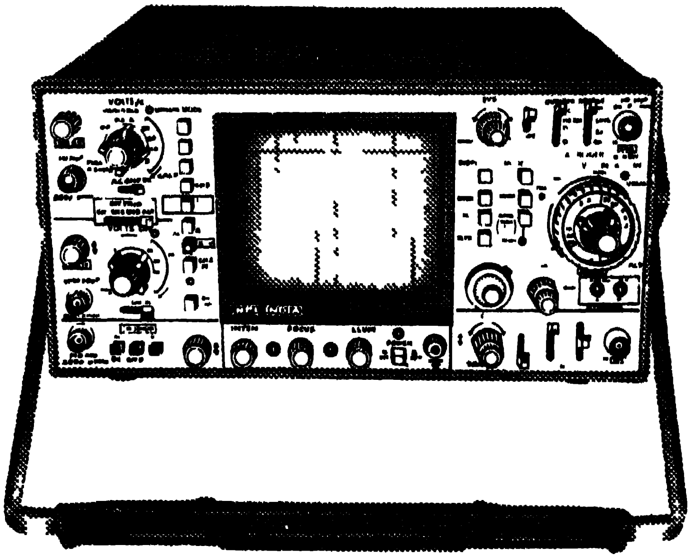

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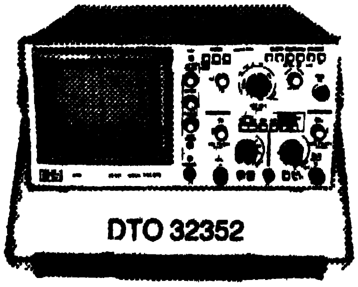

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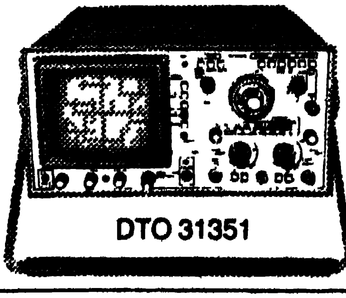

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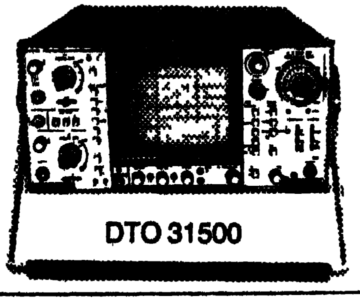

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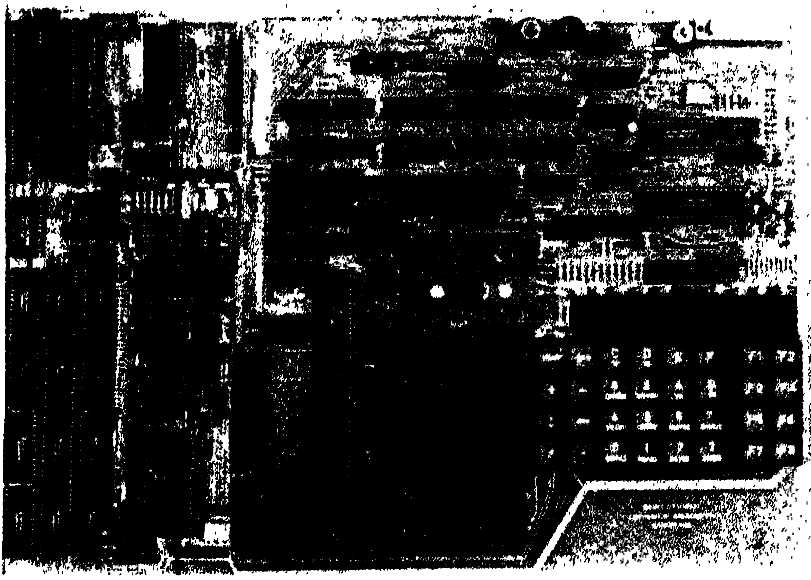

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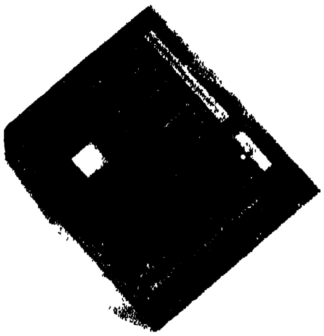

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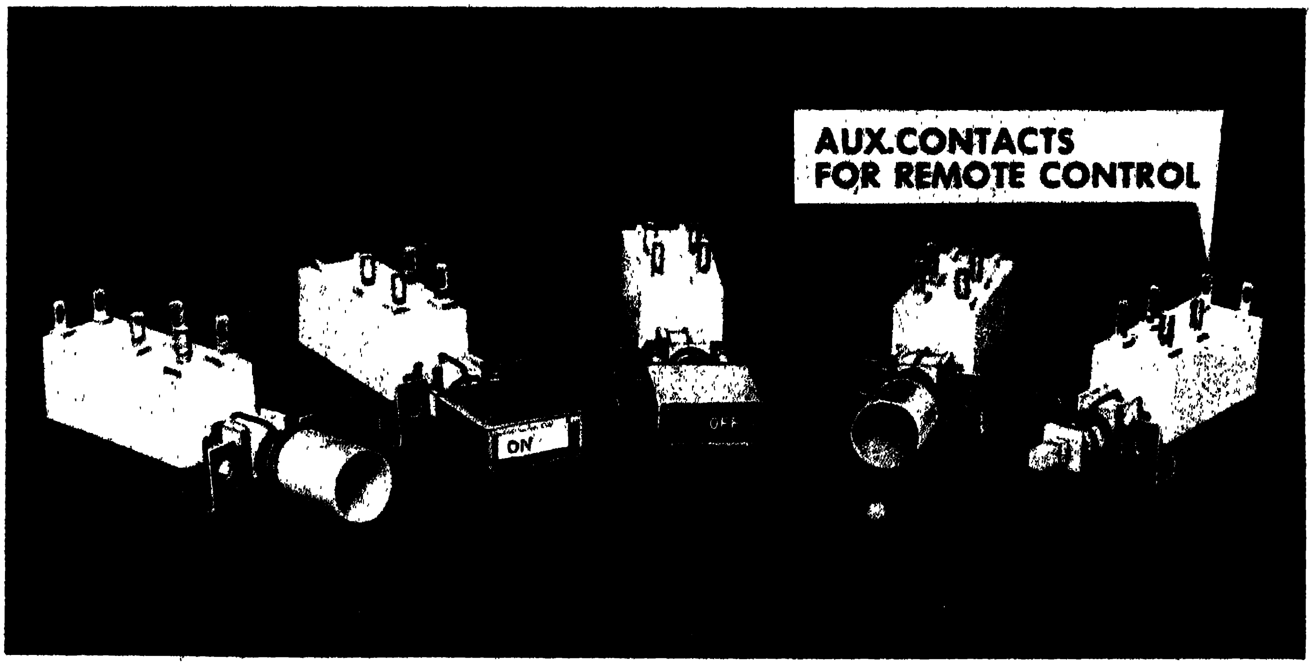

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Development of Bulgarian Electronics

A Special Correspondent

Electronics and electrical engineering in the Peoples Republic of Bulgaria are looked upon as branches of the national economy, having an influence on the processes of renovation and modernisation of production, service and everyday life. This branch yields production which represents over 12 per cent of the industrial production of the country and accounts for over 16 per cent of the country's exports.

The export list of FTO 'Isotimpex' has been annually expanded with respect to volume and nomenclature and improving its structure as the percentage of the complex projects constantly increases. Bulgaria's electronics goods are at present exported to over 60 countries in Europe, Asia, Africa and America.

The rapid rate of development of Bulgarian electronics was the result of the activities of dozens of scientific-research institutes, centres for development and implementation, specialised engineering and foreign trade organisations and professional-educational institutions.

The participation of Bulgaria in the socialist's integration, international division of labour, specialisation and industrial cooperation with the leading companies in this field all over the world, are very important for the dynamic development of electronics in the country.

The international markets where FTO 'Isotimpex' sells its products represent a unified system which is determined by the world advance in science and technique. This system is characterised by the constant expansion of commodity nomenclature and rapid improvement and substitution of the existing assortments and models.

In defining the technical policy of development of the electronics industry in Bulgaria, the technical tendencies operative on a world scale are taken into consideration, the tendency of digital realisation of electronic products being the chief concern. This tendency influences all main trends of development of the Bulgarian electronics industry, most of all, the computing equipment. Strengthening and expanding of the positions gained in the production of memory disc drives and memory tape drives, magnetic information carriers, processors, units and systems for data preparation, teleprocessing systems, problem-oriented complexes and application computing systems will continue.

In the sphere of memory disc drives, the development and implementation in regular production of units with capacity of 200 MB has been expedited and development of memory drives with capacities of 317 MB, 500 MB, 1000 MB has been planned for the future. In the production of floppy disc memory drives—standard and micro-variant—the development will be directed towards an increase of record density, both in unilateral and bilateral performance. The whole range of magnetic carriers for floppy-, mini-, and large-memory disc drives will be adopted in stages. The development of memory tape drives will continue in the direction of increasing the speed of information exchange up to 320 kB/sec in recording on the principle of phase modulation and 786 kB/sec in group coding of the record. The field of mini-tape memory drives will apply as a recording method of the phase modulation. The speed of movement of the tape will reach 2 m/sec which will ensure a speed of information exchange of 128 kB/sec.

The production of central processors for large electronic computing machines will continue, developing at the same time, specialised processors, including matrix processor for electronic computing machines. Various modifications of mono-console system for data preparation on magnetic tape will be developed in the following years. These include a terminal printer, visual monitor display of input information, a complete unification of the tape-driving mechanism and mini-tape units.

Priority will be given to the tasks for creation of program technical complexes and systems for application in commerce, agriculture, state savings banks, etc. A number of application computing systems such as, automation of engineering labour on the basis of multi-processor minicomputer systems, network for data transmission, specialised minicomputers, etc will also be worked out.

Organisation equipment is another perspective trend—it will continue the adoption of complete bureau-systems, including typewriting, multiplying, registrating and computing techniques, stenography and text processing machines, electronic calculators, etc.

The enumerated spheres of development of electronics do not exhaust all aspects of development of this branch, but they can give a general idea about the perspectives of this powerful branch of industry in Bulgaria.

The realisation of these goals is faced by the task of not only raising the prestige of the Bulgarian electronics, but also ensuring a more complete satisfaction of the requirements, both on the home and on the international market. □

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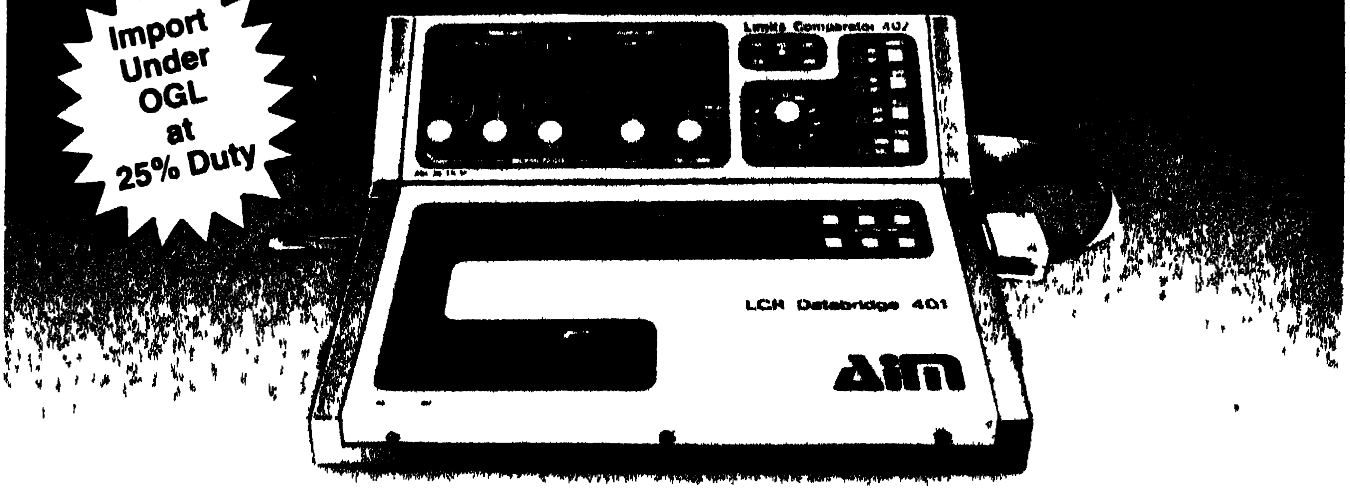

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Computer Corner

Maegaware goes public

Maegaware Computers Limited [MCL], Bombay, a new compnay promoted by Ms Aparna Y. Mafatlal, a qualified computer professional trained in the USA and co-promoted by Maegabyte Consultancy Services Private Limited, Bombay entered the capital market on January 23, with a public issue of 460,000 equity shares of Rs 10 each for cash at par.

Maegaware Computers Limited was incorporated in October 1984 as a private limited company which was later converted into a public limited company on December 19, 1985. MCL has an authorised capital of Rs 10 million.

The equity issue would be used to finance part of the project cost of Rs 9.4 million to manufacture New Brain computers. MCL is providing for the first time in the country an affordable 32 kB microcomputer expandable up to 2 MB with modular expansion. And for the first time an Indian computer manufacturer will indigenise its production in a phased manner from the first year of its operations.

In the year ending March 31, 1987, MCL expects to produce 5000 8-bit personal computers and peripherals along with other accessories like disc controllers and communication interfaces. The New Brain is a low-priced microcomputer costing around Rs 7500.

Allied starts floppy discs production

Allied Electronics & Magnetics Ltd has started producing floppy diskettes for computers at Udaipur in Rajasthan. The plant costing Rs 16 million has capacity to produce two million diskettes per year.

According to Mr Rajiv Bapna, director and a non-resident computer professional currently residing in Los Angeles, the production of floppy diskettes involves extraordinary precision and quality control. The Allied plant utilises a competely airconditioned and dust-free environment.

It is estimated that Indian floppy requirement in 1985 was somewhere between three quarter to a million pieces, all of which was imported. Foreign exchange outflow on this is estimated at Rs 15 million which could rise substantially as demand for floppies increases. Thus indigenous production of these floppies will have significant impact on foreign exchange outflow.

Dobbelin & Boeder, the technical collaborator of the project from West Germany, is a leading manufacturer of floppy diskettes. Its 'Disky' brand exceeds most of the standards set by American National Standards Institute [ANSI], German Standards Institute [DIN], and International Standards Organisation [ISO]. The Indian 'Amkette' diskettes conform to all the standards set by disky.

CAL bags order for supply of BBC Micro

CAL Systems Pvt Ltd, New Delhi has won a fiercely fought tender for supply of BBC Micro configurations to CMC Ltd.

A dual floppy drives-based configuration with RGB monitor is being supplied by CAL for bulk requirements of CMC and onward supplies to other government departments.

CALSOFT, a subsidy of CAL, is marketing the BBC Micro system software for the CLASS project in schools and colleges. This software has been published for the first time in India and NCERT has already approved 15 of these educational software packages. The floppy based software is available along with original manuals, plastic jackets, etc in the range of Rs 150 each. Subjects covered are physics, chemistry, mathematics, economics, etc as per the CBSE guidelines. Multiple copies of software are also available.

DoE to acquire CAD, CAM systems

The Department of Electronics of the government of India, is acquiring CAD [computer-aided design] and CAM [computer-aided management] systems from US firms. While the former designs packages for structural engineering, the latter helps in development of techniques in operational research, design optimisation and management of public utilities/facilities [see article 'CAD CIM CAM' elsewhere in this issue]. In addition, the DoE is also contracting to get two supercomputers from the USA.

Disclosing this at the inauguration of the 3-day show on 'computers, software electronic components and equipment' at New Delhi recently Dr Sanjeevi Rao, former chairman of the Electronics Commission said, the DoE, along with the NIC [National Informatics Centre] was developing a national informatics network to promote computerisation of socio-economic data.

The show was organised by the Indo-American Chamber of Commerce and the US and Foreign Commercial Service.

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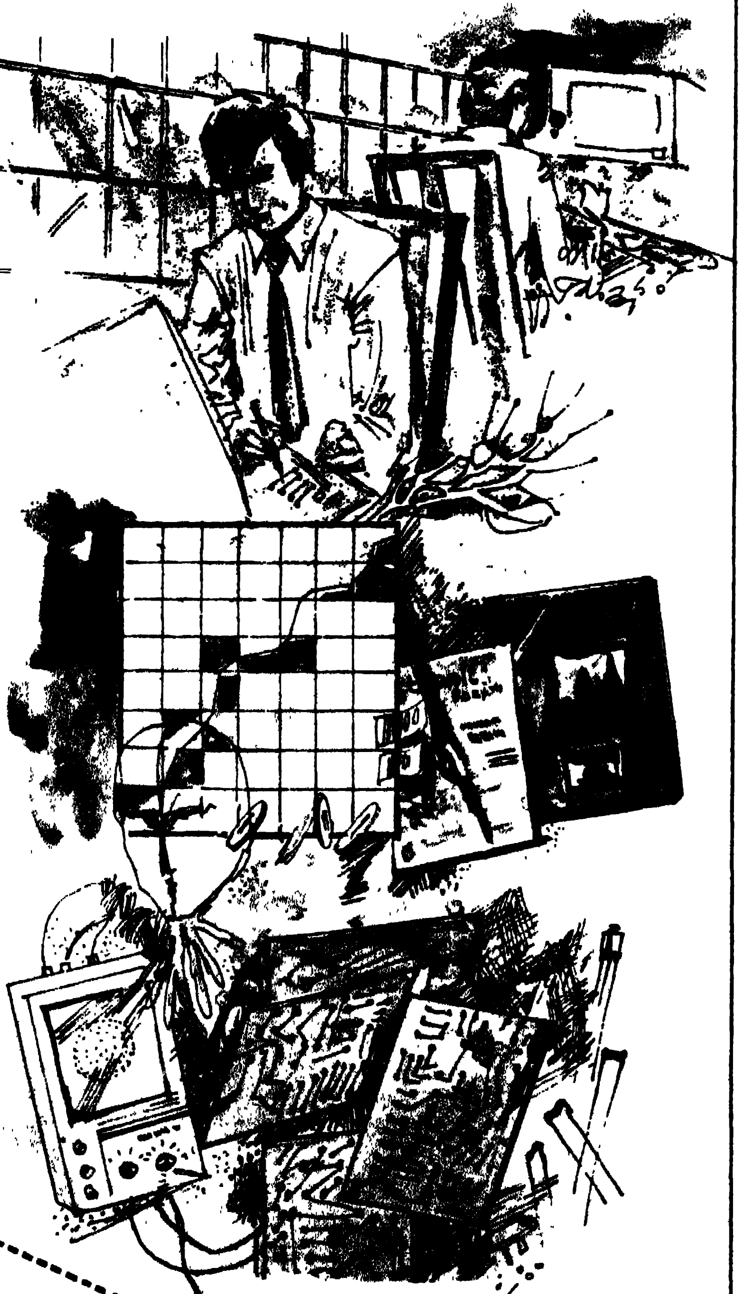

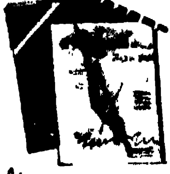

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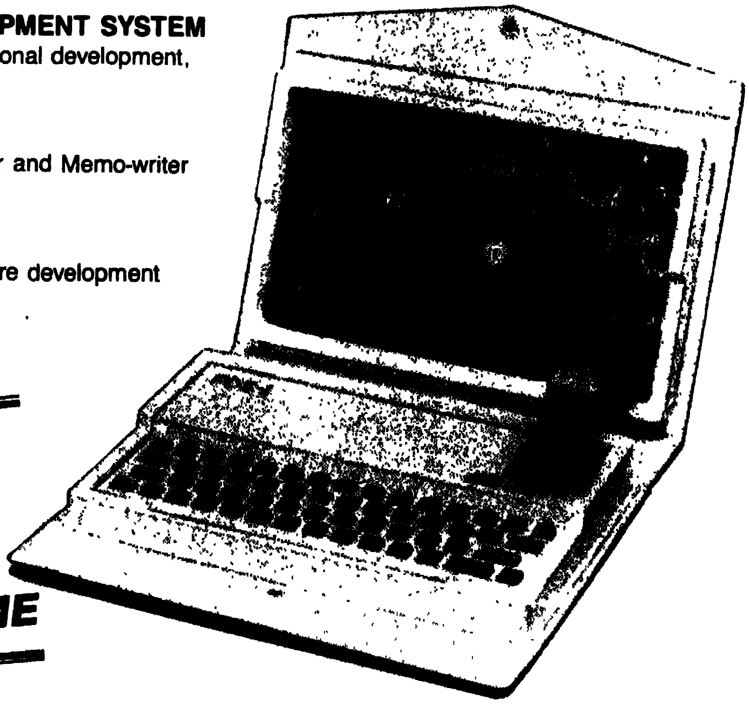

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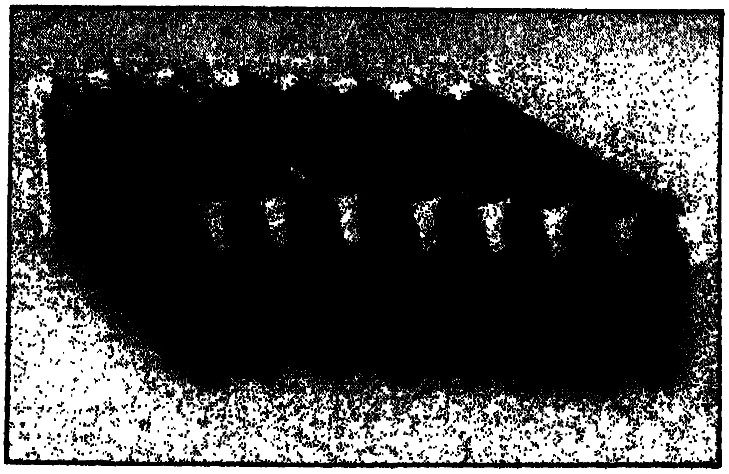

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Program for Design of Power Transformer

Anil Kumar Malik

Power transformers are being used in power supplies and every electronic instrument. So, one can design them without having to do a lot of calculations and referring to the tables for SWG and other data necessary to design, provided one has a microcomputer available. This article describes the design of a power transformer by computer programming in BASIC.

Following points have been taken into consideration while making the program:

1. The efficiency of transformer has been taken as 85 per cent.
2. It can design a transformer with maximum of five secondary windings.
3. Design is based on high-quality CRGO stampings and current density at 200 amps/cm² of enamelled copper wire.
4. It will display "OUT OF RANGE" if current in any of the windings exceeds 16.6 amps.

One can modify the data on maximum current capacity of the conductor, turns/cm² and SWG depending upon one's own requirement and specification. This data can be changed in the DATA statements.

After running the program the computer will ask you the following questions:

1. Primary voltage in volts?
2. Frequency in Hz?
3. Wave-shape (Sine/Square)?
4. If you have more than one Sec. winding?
5. Sec. voltage in volts?
6. Sec. current in amps?

After inputting this information, it will display the results in the following format:

1. Primary turns and guage
2. First Sec. turns and guage
3. Second Sec. turns and guage
4. Third Sec. turns and guage
5. Fourth Sec. turns and guage
6. Fifth Sec. turns and guage
7. Core area
8. Tongue width
9. Window area

With the results in (7), (8) and (9) one can select the type of core required for the transformer. One example is given in the program with the following specifications to make things clear:

1. Primary voltage in volts? 230
2. Frequency in Hz? 50
3. Wave-shape (Sine/Square)? Sine
4. If you have more than one Sec. voltages, Y/N? N
5. Sec. voltage in volts? 7.5
6. Sec. current in amps? 0.5

This program will run successfully on any microcomputer based on standard BASIC language. For personal computers the grammar of some of the statements will have to be changed or modifed. The language of the BASIC statements

---

Mr Anil Kumar Malik is scientist/engineer in Electronics Test and Development Centre, SAS Nagar

PROGRAM LISTING

```
5 REM PROGRAM TO DESIGN POWER TRANSFORMER
10 FOR M=1 TO 50
15 PRINT "*";
20 NEXT M
25 DIM A(40),B(40),W(40)
30 DATA 16.6,8.7,10,13.638,10.4,11,10.961,12.8,12,8.579,16.1
32 DATA 13,6.487,21.5,14,5.254,26.8,15,4.151,35.2,16,3.178
34 DATA 45.4,17,2.335,60.8,18,1.662,87.4,19,1.313,106,20
36 DATA 1.0377,137,21,0.7945,176,22,0.5838,224,23,0.4906
38 DATA 286,24,0.4054,341,25,0.3284,415,26,0.2726,504,27
40 DATA 0.2219,609,28,0.1874,711,29,0.1558,881,30,0.1364
41 DATA 997,31,0.1182,1137,32,0.1013,1308,33,0.0858,1608,34
42 DATA 0.0715,1902,35,0.0586,2286,36,0.0469,2800,37,0.0365
43 DATA 3507,38,0.0274,4838,39,0.0233,5595,40,0.0197,6543
44 DATA 41,0.0162,7755,42,0.0131,9337,43,0.0104,11457,44
45 DATA 0.0079,14392,45,0.0059,20223,46,0.0041,27546,47,0.0026
46 DATA 39706,48,0.0015,62134,49,0.0010,81242,50
50 FOR N=0 TO 40
55 READ A(N),B(N),W(N)
60 NEXT N
65 PRINT
70 INPUT "PRIMARY VOLTAGE IN VOLTS ",V(1)
75 INPUT "FREQUENCY IN HZ",F
80 INPUT "WAVE-SHAPE(SINE/SQUARE)";W$
85 IF W$="SINE" THEN 100
90 K=4
95 GOTO 105
100 K=4.44
105 INPUT "IF YOU HAVE MORE THAN ONE SEC. VOLTAGES,Y/N",A$
110 IF A$="Y" THEN 130
115 INPUT "SEC. VOLTAGE IN VOLTS",V(2)
120 INPUT "SEC. CURRENT IN AMPS ",I(2)
125 GOTO 150
130 PRINT "ASSIGN 0 VALUE FOR THE BALANCE VOLTAGES & CURRENTS"
135 INPUT "SEC. VOLTAGES IN VOLTS",V(2),V(3),V(4),V(5),V(6)
140 INPUT "SEC. CURRENTS IN AMPS ",I(2),I(3),I(4),I(5),I(6)
150 REM P2 IS OUTPUT POWER
155 P2=V(2)*I(2)+V(3)*I(3)+V(4)*I(4)+V(5)*I(5)+V(6)*I(6)
160 REM C1 IS X-SECTIONAL AREA
165 C1=1.152*SQR(P2)
170 REM T IS TURNS PER VOLT
180 T=1/(K*10^(-4)*F*C1*1.3)
185 REM I(1) IS PRIMARY CURRENT
190 I(1)=P2/(V(1)*.85)
200 REM T(1) IS PRIMARY TURNS
205 T(1)=V(1)*T
210 REM T(2),T(3)-----ARE SEC. TURNS
215 FOR P=1 TO 6
220 FOR D=1 TO 40
225 IF I(P)>16.6 THEN 590
230 IF I(P)=A(D) THEN 260
235 IF I(P)>A(D) THEN 280
240 IF I(P)=0 THEN 300
245 NEXT D
250 NEXT P
255 GOTO 330
260 Q(P)=B(D)
265 S(P)=W(D)
270 S$(P)="S.W.G"
275 GOTO 250
280 Q(P)=B(D-1)
285 S(P)=W(D-1)
290 S$(P)="S.W.G"
295 GOTO 250
300 Q(P)=10
305 S(P)=0
310 S$(P)="(NOT APPLICABLE)"
320 GOTO 250
330 REM Q(1),Q(2)-----ARE PRIMARY & SEC. TURNS/SQ.CM
340 REM S(1),S(2)-----ARE S.W.G FOR PRIMARY & SEC. WINDINGS
350 FOR E=2 TO 6
360 T(E)=T*V(E)*1.03
370 NEXT E
380 REM W1 IS WINDOW AREA
390 W1=1.3*(T(1)/Q(1)+T(2)/Q(2)+T(3)/Q(3)+T(4)/Q(4)+T(5)/Q(5))
395 W1=W1+1.3*(T(6)/Q(6))
400 REM C2 IS GROSS CORE AREA
410 C2=C1/.9
420 REM T7 IS TONGUE WIDTH
430 T7=SQR(C2)
433 T7=T7*100
434 T7=INT(T7)/100
435 C1=C1*100
436 C1=INT(C1)/100
437 W1=W1*100
438 W1=INT(W1)/100
440 FOR F=1 TO 6
450 T(F)=INT(T(F))
460 NEXT F
470 FOR M=1 TO 50
480 PRINT "*";
485 NEXT M
490 PRINT
495 PRINT
500 PRINT "   PRIMARY TURNS & GAUGE:";T(1),S(1);S$(1)
510 PRINT
520 PRINT "FIRST SEC. TURNS & GAUGE:";T(2),S(2);S$(2)
525 PRINT "SECOND SEC TURNS & GAUGE:";T(3),S(3);S$(3)
530 PRINT "THIRD SEC. TURNS & GAUGE:";T(4),S(4);S$(4)
535 PRINT "FOURTH SEC TURNS & GAUGE:";T(5),S(5);S$(5)
540 PRINT "FIFTH SEC. TURNS & GAUGE:";T(6),S(6);S$(6)
545 PRINT
550 PRINT "CORE AREA:",C1;"SQ.CM"
560 PRINT "TONGUE WIDTH:",T7;"CM"
570 PRINT "WINDOW AREA:",W1;"SQ.CM"
580 GOTO 600
590 PRINT "DESIGN OUT OF RANGE"
600 END
```

```
Primary Turns & Gauge : 3572      41 S.W.G
First Sec. Turns & Gauge: 119     23 S.W.G.
Second Sec. Turns & Gauge: 0      0 (Not Applicable)
Third Sec. Turns & Gauge:  0      0 (Not Applicable)
Fourth Sec. Turns & Gauge: 0      0  (Not Applicable)
Fifth Sec. Turns & Gauge:  0      0 (Not Applicable)
Core Area:          2.23 Sq. cm
Tongue Width:       1.57 cm
Window Area:        1.4 Sq. cm
```

accepted by the personal computers (such as the Sinclair ZX Spectrum) is somewhat different from the standard BASIC language. The statements accepted by the different personal computers may be the same but the grammar used in these statements differs. So, one has to modify the statements for the program depending upon the language of the computer.

For example, the statement 25 DIM A(40), B(40), W(40) (see program listing) may not be acceptable to the Sinclair ZX Spectrum PC if its memory is less, since this program requires 4k-byte memory. The statement 85 IF W$ = "SINE" THEN 100 which may not be acceptable to the PC as it is, may be acceptable with a slight change in the grammar as:

85 IF W$ = "SINE" GO TO 100 or
85 IF W$ = "SINE" THEN GO TO 100 □

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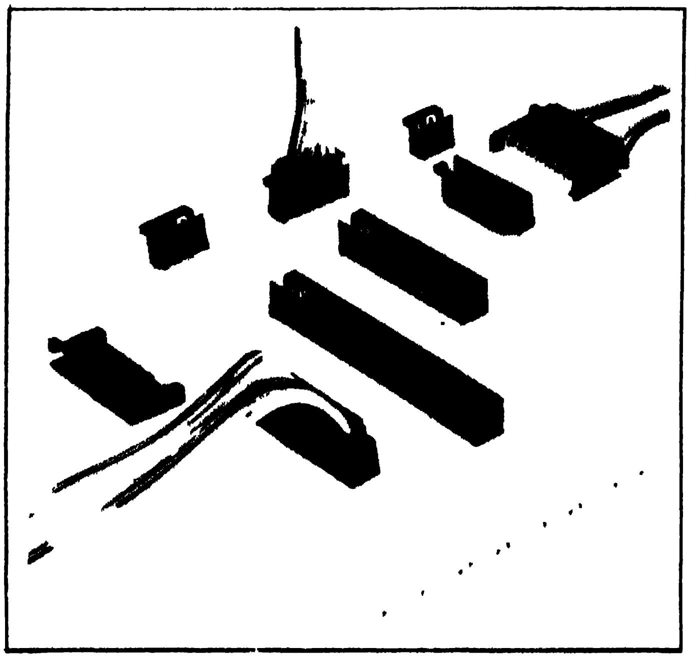

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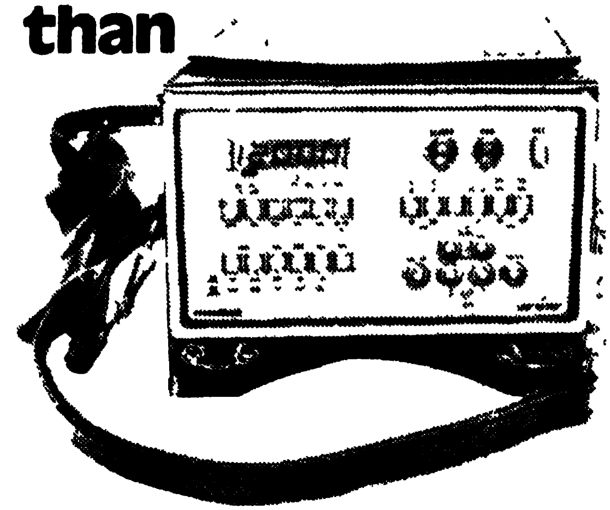

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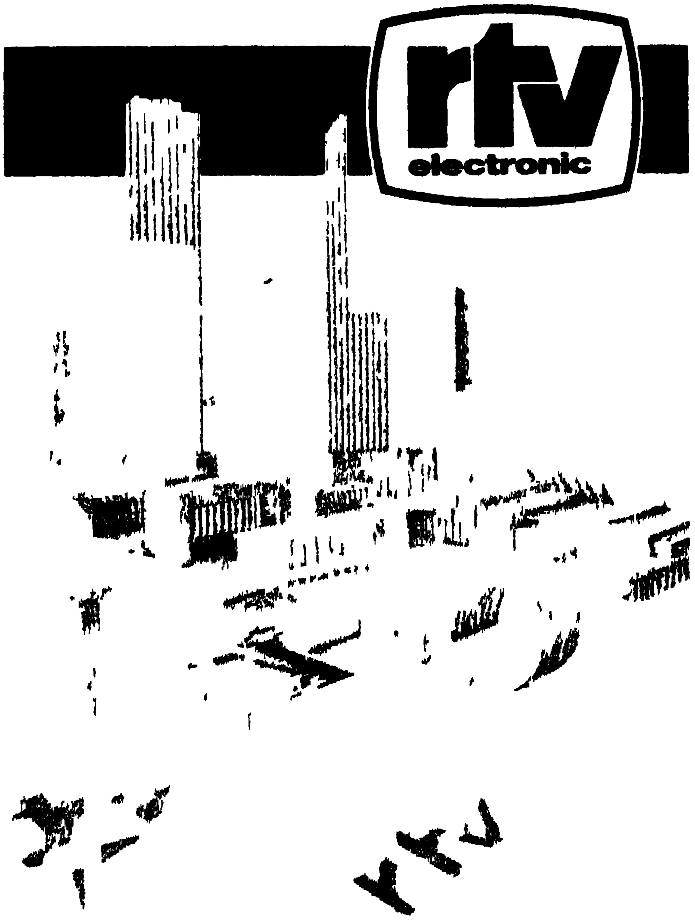

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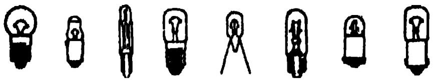

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Comparative Study of Computer Languages

Computation Statements

Part IX

R. Ramaswamy

Programming a computer consists in writing down instructions to the computer in a symbolic language or in a high-level language like FORTRAN, COBOL, BASIC, PL/1, PASCAL, etc which the machine can decipher. The machine cannot directly execute the instructions given in high-level languages. The only language which the machine can obey is the machine language. So programs in symbolic languages are converted to machine languages before the machine can start executing them.

We write the programs only in symbolic languages because it is easier this way. Such programs are called source programs. These programs are converted to machine language programs by means of appropriate compilers. The machine language programs are called the object programs. Compiler is another program which converts the source programs in high-level languages to object programs in machine languages. Instructions in high-level languages are written in the form of statements.

Statements are the basic units from which programs are built. A statement in computer language is analogous to sentences in spoken languages. Just as a sentence gives complete sense to the humans, a statement gives complete meaning or sense to the computer. Statements constitute the commands or instructions to the computer to do specific jobs like computing an expression, assigning values, transferring controls, printing the results, giving information to the computer and so on. There are different types of statements to do different jobs.

Executable and non-executable statements

Statements are broadly classified as executable and non-[illegible]utable. Statements which are used to give information to the computer or to the readers are called non-executable statements. For example, declaration statements give information to the computer. They are non-executable. Comment statements give information to the readers and they are also non-executable. Executable statements cause the computer to do some functions like reading data, outputting the result, computing an expression and so on.

The following are examples of executable statements:

1. Computation statements
2. Input statements
3. Output statements
4. Control statements

The following are examples of non-executable statements:

1. Comment statements
2. Declaration statements
3. Format statements
4. Subroutine defining statements

In this lesson, we will study the features of the computation statement or the assignment statement or the arithmetic statement in the different languages.

Computation statement in FORTRAN

The computation statement can also be called the arithmetic statement or the assignment statement. The computation statement is probably the most important statement in any computer language since it is only this statement that gives the result or solution to any problem. The general form of a computation statement is:

Variable = Expression

or simply V = E

where V is any unsigned variable (integer or real), and E is any valid FORTRAN expression (integer or real). The two entities are separated by the symbol =, called the assignment operator. The above form of statement instructs the computer to calculate or compute the value of the expression on the right hand side (RHS) of the assignment operator and store the value in the variable on the left hand side (LHS) of the assignment operator.

The symbol = is also called the replacement operator. It does not have the same meaning as the equality symbol used in conventional algebra. For example, if we write A = B in algebra, it means that the values of A and B are equal or the values on the LHS and the RHS are equal. If we write A = B in FORTRAN, it means that the value of B is assigned to A, whatever may be the original value of A. This means that the values of A and B may be unequal before writing the above statement. After writing the statement, the value of B is assigned to A. That is why the above statement is also called the assignment statement.

This is not called equality statement in FORTRAN. Suppose one writes:

```
A = A + 1.0
```

This statement is illegal in conventional algebra because it requires that the LHS and the RHS must be equal prior to writing the statement. Obviously, A cannot be equal to A + 1.0. But this statement is legal in FORTRAN, since its meaning is different. This means that the old value of A is added to 1 and is assigned as the new value to the same variable A. If the old value of A is 25.0, then the new value of A after executing the above statement becomes 26.0. In summary, an arithmetic statement or a computation statement or an assignment statement in FORTRAN, does the following three things:

1. It evaluates the expression on the RHS of the assignment symbol.
2. If required, it converts the mode of the evaluated result to the mode of the variable to the left of the assignment symbol.
3. It stores the result obtained from the second step as the value of the variable given on the LHS of the assignment sign.

Suppose the value of I is 2 and one writes:

```
A = I
```

We find that the RHS is in the integer mode and the LHS is in the real mode. Since the storage mode is real, the number is stored as 2.0 in the variable A. Suppose the value of A is 2.0 and one writes:

```
I = A
```

We find that the RHS is in the real mode and the LHS is in the integer mode. Since the storage mode is integer, the number is stored as 2 in the variable I. Suppose the value of A is 2.5, then the above statement stores only the integer part of A after truncating the decimal part. That is, I will store only 2. We may have to do such conversions in our computations later since a problem logic may require such conversions.

The following are examples of valid FORTRAN arithmetic or computation or assignment statements:

```
    A = X + Y+Z/B
    I = B + C/D + 23.5
    I = 123.4/56.7* 23.9
    B = 23/67 + 123/78 -67/23
    A = I
    I = -A
    I = 112.1/1.2
    C = 146/2 + 192/16
  VOL = 3.143*R**2*H
```

Consider the example I = 112.1/1.2. The variable on the LHS is in the integer mode whereas the expression on the RHS is in the real mode. The computer evaluates the expression on the RHS in the real mode and gets the result as 93.416666. But the storage on the LHS is in the integer mode. So the integer part of the computed value on the RHS alone is taken and the result stored simply as 93 in the location I. In the example C = 146/2 + 192/16, the LHS is in the real mode and the RHS is in the integer mode. The computation of RHS gives 85 and it is stored in the variable C as 85.0. In summary, we say that the expression on the RHS is evaluated in the mode in which it is framed and converted into the mode in which it is required to be stored by the variable on the LHS. The mode of the variable on the LHS decides the mode of the result.

The following are examples of invalid FORTRAN arithmetic statements:

A = 3.0X + B	(An operator between 3.0 and X is missing)
-K = A + B	(The LHS cannot be a signed variable)
A + B = C + D	(The LHS cannot be an expression)
B = C + 9	(The expression on the RHS is in the mixed mode and hence not permitted)
24 = A + B	(The LHS cannot be a constant)
EXP(X) = A**2	(The LHS cannot be a library function)
A+B+C	(An arithmetic statement must have an assignment symbol. The example is simply an expression and not an arithmetic statement)

What does a computation statement look like?

A computation statement looks like a formula. We know that a formula has a variable on the LHS and an expression on the RHS, the two being separated by the symbol (=). The computation statement also has the same structure. We know that the solution to a problem lies on the LHS of a formula. In the same way, the solution to a problem lies only on the LHS of a computation statement. Since a computation statement contains the solution to a problem, we say that it is the most important statement in any programming language. If at all the solution to a problem is to be output by a computer, it must appear as a value of a variable on the LHS of an assignment or a computation statement. Our objective in life is to find solutions to problems. We find that solutions lie on the LHS of computation statements and that is why computation statements are the most important ones.

Computation statement in COBOL

Whatever be the computer language used, a computation statement has the same purpose or function, i.e., to instruct the computer to compute the expression on the RHS of the assignment operator and store the value in the variable on the LHS. The coding forms may slightly vary from language to language. The general form of the computation statement in COBOL is:

```
COMPUTE Variable -1 =(variable -2)
                     (literal)
                     (arithmetic expression)
```

In writing general forms in COBOL, certain notations are used: Small case letters indicate that they are programmer coined; vertically stacked items inside braces imply that one of the enclosed items must be used; items given in square brackets are optional and the ellipsis (...) or three dots indicates that the preceding items can be repeated if required.

The following are examples of valid arithmetic statements.

```
COMPUTE AREA = X
COMPUTE VOLUME = 32
COMPUTE GROSS-PAY = BASIC-PAY +
                    ALLOWANCES
```

The computer is instructed to compute the expression on the RHS of the assignment symbol (=) and store the value in the variable on the LHS. When we say COMPUTE AREA = X, the value of the variable X is asked to be stored in the variable AREA. In the second example, the literal 32 is assigned to the variable VOLUME. In the third example, the computed value of the expression in the RHS is stored in the variable GROSS-PAY. The form of the computation statement is similar to FORTRAN, except that the word COMPUTE precedes the variable on the LHS. The word COMPUTE comes from the reserved words list.

Descriptive form of computation statement

In COBOL, there is another form of writing the computation statement using descriptive forms for the operators instead of symbolic forms. These forms use the descriptive verbs, ADD, SUBTRACT, MULTIPLY and DIVIDE. The exponential operator has no corresponding verb.

ADD statement

There are two forms of the ADD statement. They are as follows:

```
ADD (literal-1)
    (variable-1)     ... TO (variable-3)
ADD (literal-1)     (literal-1)
    (variable-1)  (variable-2)  ... GIVING (variable-3)
```

In the first form, all the operands preceding the word TO are first added and the result is then added to the item following the word TO and stored in that field. For example, if one writes:

```
ADD A, B, C, TO D
```

A, B, C are added first. Then this total is added to the variable D on the RHS of the word TO and stored in that variable. The old value of D disappears. D is called the receiving or the storing field. The storing field must always be a variable. The above ADD statement is equivalent to the following COMPUTE statement:

```
COMPUTE D = D + A + B + C
```

In the second form, the operands preceding the word GIVING are added and the result stored in the variable succeeding the word GIVING. If one writes:

```
ADD A, B, C GIVING D
```

A, B and C are added and the sum replaces the field D. The old value of D disappears. The above ADD statement is equivalent to the following COMPUTE statement:

```
COMPUTE D = A + B + C
```

It must be noted that one must not write ADD A TO 5 since the receiving field or the storing field is not a variable. But one can write ADD 5 TO A. In this case, 5 is added to A and the sum stored in the field A.

SUBTRACT statement

There are two forms of the SUBTRACT statement. They are:

```
SUBTRACT   (variable-1) ... FROM (variable-2)
           (literal-1)
SUBTRACT   (variable-1) ... FROM (variable-2)
           (literal-1)           (literal-2)
                          GIVING (variable-3)
```

In the first form, all the operands before the word FROM are added and the sum subtracted from the operand succeeding the word FROM and stored in that operand. If one writes:

```
SUBTRACT A, B, C FROM D
```

A, B and C are added first. This sum is then subtracted from D and the result stored in D itself. The old value of D disappears. This is equivalent to the following COMPUTE statement:

```
COMPUTE D = D - (A + B + C)
```

In the second form, all the variables preceding the word FROM are added and the sum subtracted from the variable immediately following the word FROM and stored in the variable immediately following the word GIVING. If one writes:

```
SUBTRACT A, B, C, FROM D GIVING E
```

A, B and C are added first, the sum subtracted from D and then the result stored in the location E. The old value of E disappears. This is equivalent to the following COMPUTE statement:

```
COMPUTE E = D - (A + B + C)
```

MULTIPLY statement

There are two forms of the MULTIPLY statement. They are as follows:

```
MULTIPLY (variable-1) BY (variable-2)
         (literal-1)
MULTIPLY (variable-1) BY (variable-2)GIVING
         (literal-1)      (literal-2)  (variable- 3)
```

If one writes:

MULTIPLY A BY B

then A is multiplied by B and the product stored in B. This is equivalent to the following COMPUTE statement:

COMPUTE B = A * B

If one writes:

MULTIPLY A BY B GIVING C

then A is multiplied by B and the product stored in C. This is equivalent to the following COMPUTE statement:

COMPUTE C = A * B

Note that one must not write MULTIPLY A BY 3, but one can write MULTIPLY 3 BY A. One can write MULTIPLY A BY 3 GIVING C. This is permitted since it is the variable C that is the storing field.

DIVIDE statement

The DIVIDE statement can be written in the following three forms:

```
DIVIDE (variable-1) INTO (variable-2)
       (literal-1)
DIVIDE (variable-1) INTO (variable-2)GIVING(variable-
       (literal-1)       (literal-2)              3)
DIVIDE (variable-1) BY (variable-2) GIVING (variable-3)
        (literal-1)      (literal-2)
```

In the first form, the variable-2 is divided by the variable-1 or the literal-1 and the quotient stored in the variable-2. If one writes:

DIVIDE A INTO B

then B is divided by A and the quotient stored in B. This is equivalent to the following COMPUTE statement:

COMPUTE B = B/A

In the above case, B must not be a literal, since it is the receiving or the storing field.

In the second form, the variable-2 or the literal-2 is divided by the variable-1 or the literal-1 and the quotient stored in the variable-3. If one writes:

DIVIDE A INTO B GIVING C

then B is divided by A and the quotient stored in C. This is equivalent to the following COMPUTE statement:

COMPUTE C = B/A

In this case, both A and B can be literals.

In the third form, the variable-1 or the literal-1 is divided by the variable-2 or the literal-2 and the quotient stored in the variable-3. If one writes:

DIVIDE A BY B GIVING C

then A is divided by B and the quotient stored in C. This is equivalent to the following COMPUTE statement:

COMPUTE C = A/B

In this case also, both A and B can be literals.

ROUNDED and SIZE ERROR options

The above two options can be given at the end of any form of arithmetic statement. When the ROUNDED option is given, the least significant digit of the resulting value is rounded off to the nearest integer. When the SIZE ERROR option is given, the control is transferred to any other para as required; if the final value after executing the ROUNDED OPTION, if any, exceeds the size of the receiving field. If one writes:

DIVIDE A BY B GIVING C ROUNDED ON SIZE
ERROR GO TO E-PARA

a SIZE ERROR arises if the number of digit spaces allotted for the result field C is less than the computed result after executing the ROUNDED option. For example, let C be allotted three digit spaces to the left of the decimal point and two digit spaces to the right of the decimal point.

Suppose the initial computed value of C is 2345.346. First the ROUNDED OPTION is executed. The value of C becomes 2345.35. We find that a SIZE ERROR condition arises since in the receiving field there are only three digit spaces to the left of the decimal point, whereas in the computed result there are four places. So in the receiving field the result appears truncated as 345.35. The most significant digit is truncated and the result becomes erroneous.

This situation is brought to the attention of the programmer by the SIZE ERROR option. When the SIZE ERROR condition occurs, the computer is asked to display the condition or take any other action appropriate to that condition by means of an imperative statement. Remember that the computer is inanimate and we have to give foolproof instructions as to what should be done under different conditions. Note that the SIZE ERROR option does not cause the printing or storing of the correct result. The above option can also be used with the COMPUTE statement as follows:

COMPUTE C ROUNDED = A/B ON SIZE ERROR
GO TO E-PARA.

Examples Illustrating the Results Obtained from the Different COMPUTE Statements

Operations	A	B	C	D	E	F
Values before operations	5	6	4	3	2	1
Values after the following operations:						
ADD A TO B	5	11	4	3	2	1
ADD A, B TO C	5	6	15	3	2	1
ADD A, B, C TO D	5	6	4	18	2	1
ADD A, B, C GIVING D	5	6	4	15	2	1
SUBTRACT A FROM B	5	1	4	3	2	1
SUBTRACT A, B FROM C	5	6	-7	3	2	1
SUBTRACT A, B FROM C GIVING D	5	6	4	-7	2	1
MULTIPLY A BY B	5	30	4	3	2	1
MULTIPLY A BY B GIVING C	5	6	30	3	2	1
DIVIDE A INTO B	5	1.2	4	3	2	1
DIVIDE A INTO B GIVING C	5	6	1.2	3	2	1
DIVIDE A BY B GIVING C	5	6	.83	3	2	1
DIVIDE 3 INTO B	5	2	4	3	2	1

Computation statement in BASIC

As already pointed out, the function of the computation statement is the same in all languages, i.e., to compute the expression and assign the computed value to a variable. The general form of the computation statement in BASIC is:

```
Variable = expression
```

or

```
V = E
```

The LHS is any valid unsigned variable and the RHS is any valid BASIC expression. The only restriction is that the variable on the left and the variables constituting the expression on the right of the assignment symbol must be of the same type (either numeric or string). The following are examples of valid computation statements:

```
X = 13.7
A$ = "BALASUBRAMANIAN"
A$ = B$ + C$ + D$
A12 = 3/13*7.4 + A/B +C -D
GROSS.PAY = BASIC.PAY + ALLOWANCES
```

The computation statement or the assignment statement does the following two things:

1. It evaluates the expression on the RHS of the assignment or the replacement symbol (=).
2. It stores the result obtained from the first step as the value of the variable given on the LHS of the replacement sign.

Consider the following computation statement:

```
A = A + 1
```

We know that an equation of this type is illegal in conventional algebra. But in computer languages it is valid. The above statement means that the old value of A is added to 1 and is stored as the new value in the same location A. It must be noted that the computer can output only the values stored by the variable on the LHS of a computation statement or an assignment statement. So, if at all any value or values are to be output by the computer, they must have appeared as values of variables on the LHS of an assignment statement. So one can easily understand the importance of computation statements.

Computation statement in PL/1

As regards the computation statement, FORTRAN, BASIC, PL/1 and PASCAL have similar structures. COBOL form of computation statements is somewhat descriptive, though the meaning is the same as in the other languages. The general form of computation statement in PL/1 is:

```
variable = expression
```

or simply `V = E`

where V is any unsigned variable and E is any valid PL/1 expression. Data types on both sides of the assignment operator must be same. The following are examples of valid computation statements:

```
CI = P*(1+R/100)**N-P
N = MOD (M, 7) + 1
S = SQRT ((A2-N*MEAN*MEAN)/(N-1))
```

Computation statement in PASCAL

The general form of the computation statement or the assignment statement in PASCAL is as follows:

```
variable := expresssion
```

or simply `V = E`

where V is any valid PASCAL variable and E is any valid PASCAL expression. The two entities are separated by a combination symbol (:=) called the assignment operator. It is only in PASCAL that the assignment operator is given a different coding from the equality sign. The meaning of the computation statement is that the computed value of the expression on the RHS of the assignment operator is assigned to the variable on the LHS. If one wants to add 1 to the old value of A and assign it to the same variable one must write the assignment statement

```
A := A + 1
```

If one writes:

```
A = A + 1
```

it is illegal in PASCAL, though it is legal in BASIC and PL/1. In FORTRAN it must be written as A = A + 1.0 to avoid the mixed mode error in the expression on the RHS. There is another hitch in writing the computation statements in PASCAL in the case of numeric entities. In the case of numeric variables we have integers and reals. If V and E are both integer types or real types there is no mismatch in the modes. If V is an integer and E is real, there is mismatch. However, if V is real and E is integer, there is no mismatch since the integer is internally converted to real and stored in the variable on the LHS.

This means that an integer can be assigned to a real variable, but a real must not be assigned to an integer variable. If A, B and C are declared as reals and E and F are declared as integers, then the following assignment or the computation statements are valid:

```
A := B*C + 3.5/6
E := E + F + E DIV F - E MOD F
A := E + F*E
E := TRUNC (A + B + C)
E := ROUND (A + B + C)
```

In the first example, both the sides are reals and so there is no problem. In the second example, both the sides are integers and so there is no problem. In the third example, the LHS is real and the RHS is integer. This is valid, since it is permissible to assign an integer to a real variable. The RHS is computed by doing integer arithmetic, converted to real and finally stored in the variable on the LHS. In the fourth example, the LHS is an integer. The TRUNC function on the RHS converts the real expression inside the argument after computation to integer, thereby avoiding the mismatch. In the last example, the ROUND function converts the real expression inside the argument after computation to integer, thereby avoiding the mismatch with the integer variable on the LHS.

So, to convert a real to integer, use either the TRUNC or the ROUND function, whichever is appropriate to the situation. For converting an integer to real assign the integer to real.

The following are examples of invalid PASCAL computation statements:

A + B := C + D (LHS cannot be an expression)
-A := B * C + D (LHS cannot be a signed variable)
A = B + C (the assignment operator is not properly coded)
25 := C -D (LHS cannot be a constant)
A := 25.5/67.8 (If A is declared as integer, it is invalid, but if A is declared as real, it is valid)
EXP(X) := A - B (the LHS cannot be a function)

Comparing different languages

Let us see how the assignment operator and the equality operator are coded in the different languages.

Language	Assignment Operator	Equality Operator
FORTRAN	=	.EQ.
COBOL	=	=
BASIC	=	EQ
PL/1	=	=
PASCAL	:=	=

In COBOL and PL/1 there is no distinction in coding the two operators. In other languages there is some difference.

COBOL is a special-purpose language in that it is intended only for programming business problems. The operational statements are highly descriptive so that they are self-documenting. Self-documenting means being self-explanatory or meaningful. The oft repeated operations in business problems are addition, subtraction, multiplication and division and these operators have descriptive forms in COBOL.

FORTRAN also is a special-purpose language in that it is intended only for scientific problems. It is not as if business problems cannot be coded in FORTRAN. It is only a question of efficiency. BASIC, PL/1 and PASCAL are general-purpose languages in that they can be used to program both business and scientific problems.

(To be continued)

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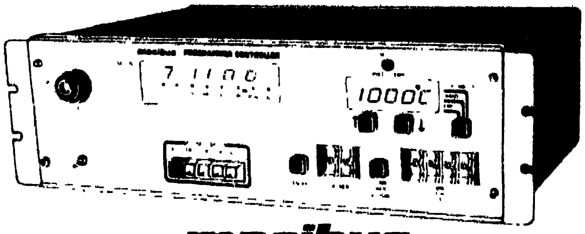

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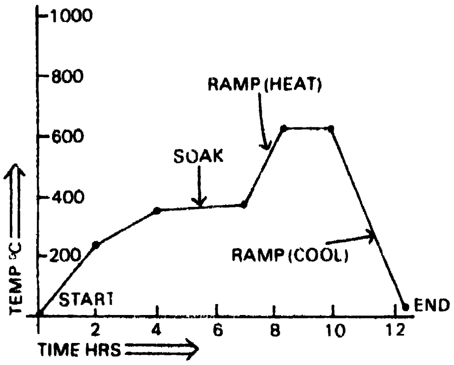

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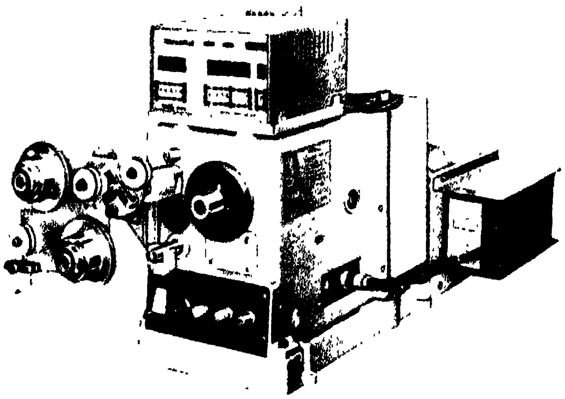

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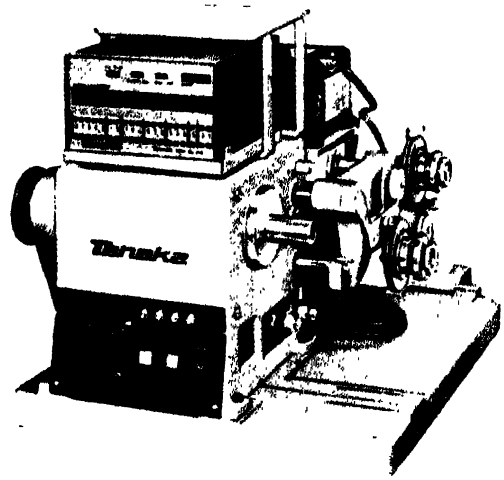

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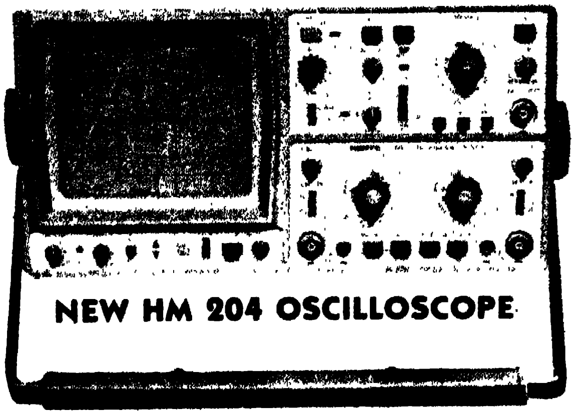

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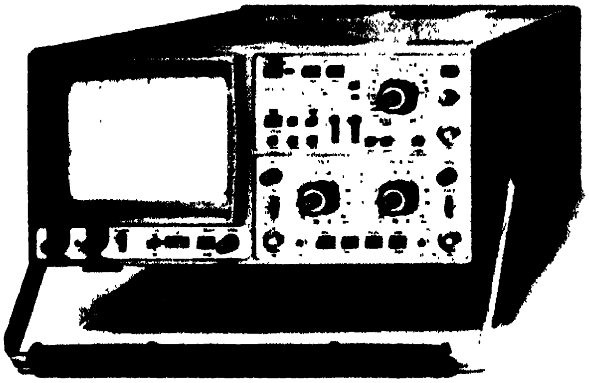

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Microprocessor Control of Stepper Motors

Part IV

Program Listing

Prof. V.V. Athani

An article on Microprocessor Control of Stepper Motors appeared in three parts in March, April and May 1985 issues of Electronics For You. Part III of the article dealt with details of how to interface the popular SDK-85 microprocessor kit with the stepper motor controller. Flow charts for constant speed and preset indexer algorithms also appeared in figures 20 and 21 respectively. Since then I have received a number of letters asking for program listings. In response to these requests, I am giving below the program listings.

Program listing

The program consists of three routiness: (i) constant speed routine; (ii) acceleration-deceleration routine; and (iii) interrupt service routines. These easy-to-understand routines are given below:

Constant speed routine

```
        Instruction            Comments
        LXIH TIMER ARRAY       Timer array is the starting
                               address of the timer count array
        LXI D, N               N: the number of the element in
                               the array corresponding to the
                               particular speed
        DAD D
        MOV A, M               Get timer value-higher byte in
                               accumulator
        OUT 2DH
        LXI D, 1
        DAD D
        MOV A, M               Get timer value-lower byte in
                               accumulator
        OUT 2C H
        LDA 2000               2000 contains higher byte of
                               'No.of steps'
        MOV B, A
        LDA 2001               2001 contains lower byte of
                                No.of steps'
        MOV C, A
        MVI A, 11000001 B      21 H is made o/p part
        OUT 28 H               Start the timer
        MVI A, 00001011 B      Unmask interrupt RST 7.5
        SIM
        EI                     Enable interrupt
        MVI D, 8               Load scale counter
HALT.   HLT
        MOV A, B
        ORA C
        JZ END                 Check if B-C is zero
B       JMP HALT
END .   RET
```

Acceleration- deceleration routine

The acceleration routine is different from the constant speed routine in that instead of

```
B       JMP HALT
```

We have

```
B       INX H                  Increment H
        JMP A
```

For deceleration routine we have

```
B       DCX H
        DCX H
        JMP A
```

Interrupt service routine

```
        PUSH H
        PUSH PSW
        DCR D
        MOV A, D
        JZ OUTPUT
        EI
        POP PSW
        POP H
        RET
OUTPUT: LDA 2002               Contains sequence bits
        OUT 21 H
        RLC                    Rotate left
        STA 2002
        DCX B
        EI
        MVI D, 8
        POP PSW
        POP H
        RET
```

---

ani is from the Electrical Engineering Department, IIT, Bombay.

Errata

There is an error in Fig. 8(a) illustrating the single stepping mode of stepper motor operation, appearing on page 23 of the March 1985 issue of EFY. The corrected figure is shown as Fig. 25. Readers are requested to note the correction. ☐

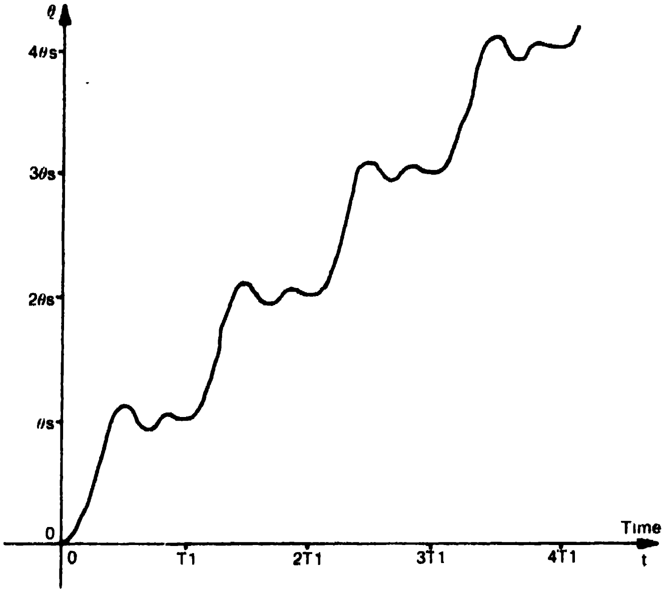

Fig. 25: Single stepping mode.

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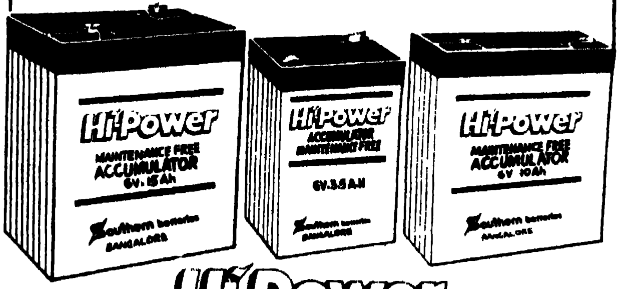

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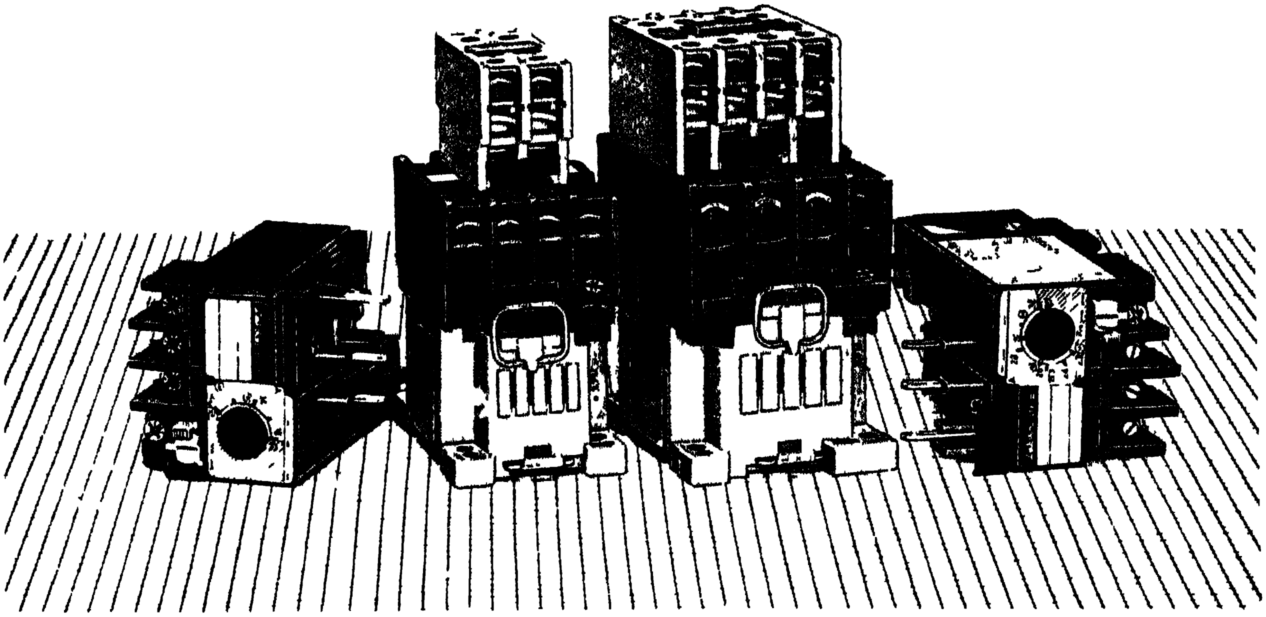

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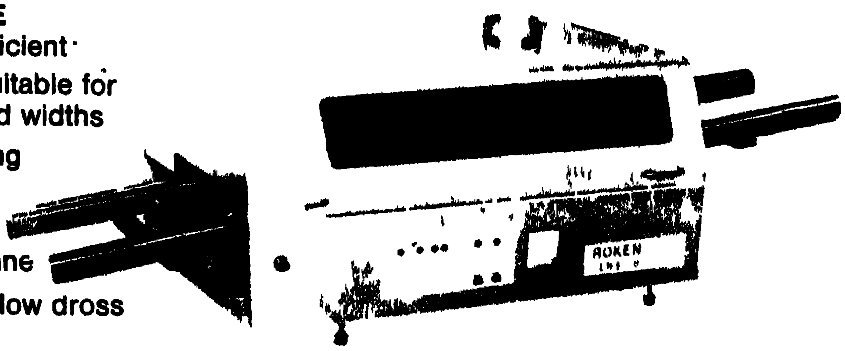

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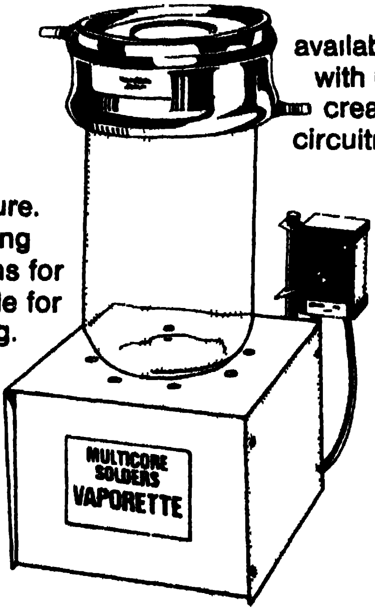

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Electronic Warfare- A Key to Combat Survival

Satish Jain

Modern warfare employs sophisticated weapons for offensive as well as defensive operations. These weapon systems use the electromagnetic spectrum for communication, guidance and control. Electronic weapons form a part of the present-day warfare wherein efforts are made either to dilute the ability of the enemy weapons or to prevent them from using radio waves as a means of guidance and control.

Radio waves are used for communication, detection or guidance of this weaponry. Mobile emitter and fast-moving, highly destructive weapons like tanks, surface-to-surface missile batteries and field guns demand rapid response time.

Planning and execution of a battle warrants collection of information from enemy airfields, air defence radar frequencies, location of weapons and troops etc. This information is collected electronically during war as well as at peace times. These data are analysed using the quickest means for processing and results are displayed to counter or launch an attack.

Tank commanders, pilots and missile battery commanders communicate, control and guide their fire power on to the targets using radio waves. Artillery commanders get the location of potential targets from air observation posts (AOPs) manned by helicopters. The pilots in these helicopters direct the artillery battery commanders to the correct projectile of the fired shells. To support all these weapons, there are communication and radar vehicles. Such vehicles are fully mobile and can be called upon at a very short notice to provide electronic eyes to field commanders.

Tables I and II summarise characteristics of the electromagnetic wave spectrum. It can be seen from Table I that radio waves in the range of 3 MHz to 300 GHz are used for long range communications, radio and radar detection as well as location and navigation applications. Beyond 300 GHz, the electromagnetic waves are used for thermal and optical sighting or in nuclear weapons.

Electronic warfare has three main objectives. These are:

1. To gather maximum intelligence from the electromag-

Mr Satish Jain is the principal consultant for Electronics and Computer Consultants, New Delhi.

Table I
Military use of the electromagnetic spectrum

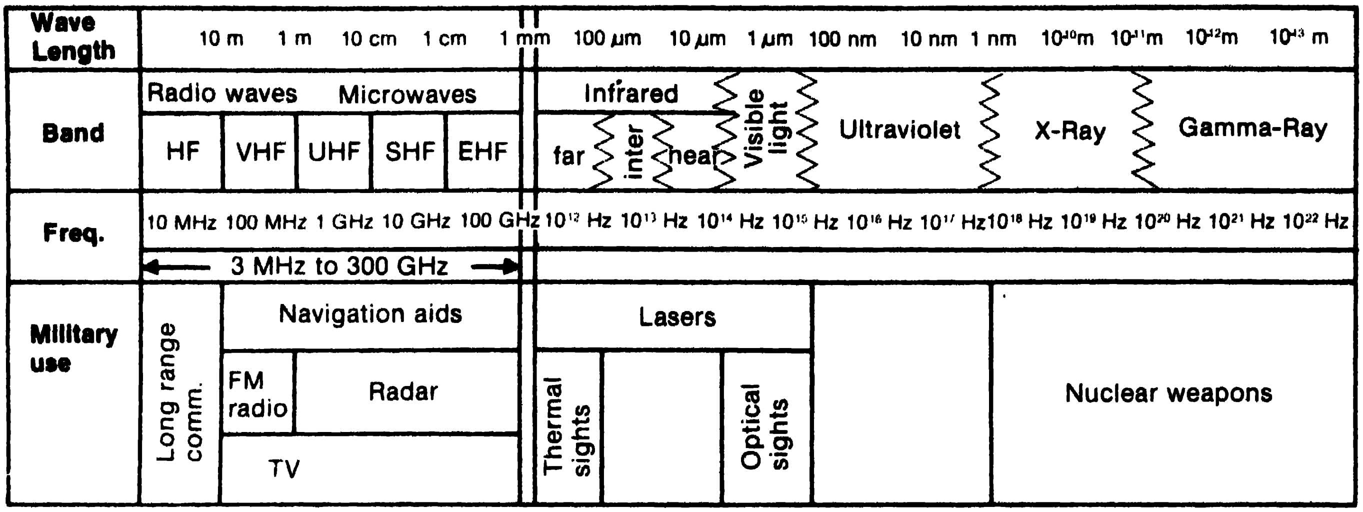


Table II
Commonly used letter-code designations for microwave frequency bands

Band	*Frequency*	*Wavelength*	*Typical Use*
P	225-390 MHz	133.3-76.9 cm	Long range (over 200 miles) to very long range (beyond 1,000 miles) surface-to-air search.
L	390-1550 MHz	76.9-19.3 cm	Very long through medium range surface-to-air missile and aircraft detection, tracking and air traffic control, IFF transponders, beacon systems.
S	1.55-5.2 GHz	19.3-5.77 cm	Medium and long range surface-to-air surveillance, surface-based weather radar, altimetry, missile-borne guidance, air-bome bomb-navigation systems.
C	3.9-6.2 MHz	7.68-4.84 cm	Airborne fire control, missile-bome beacons, recon, airbome weather avoidance, aircraft and missile target tracking.
X	5.2-10 9 MHz	5.77-2.75 cm	Doppler navigation, airborne fire control, airborne and surface-based weather detection, bomb-navigation systems, missile-bome guidance, precision landing approach.
K	10.9-36 GHz	2.75-0.834 cm	Doppler navigation, automatic landing systems, airborne fire control, radar fuzing, recon, missile-borne guidance.
Q	36-46 GHz	0.834-0.652 cm	Recon, airport surface detection.
V	46-56 GHz	0.652-0.536 cm	High-resolution experimental shortrange systems.

netic emissions made knowingly or unknowingly by the enemy by various methods of gathering electronic intelligence (ELINT).

2. To prevent enemy from using electromagnetic waves to his advantage by either transmitting at the same frequency or creating noise in the entire band of frequencies by using electronic countermeasures (ECM).
3. To make maximum use of the electromagnetic waves for guidance, control and communication with one's own weapon systems by adopting electronic counter countermeasures (ECCM).

Collection of electronic intelligence

Electromagnetic radiations are monitored all the time, both during war and peace. These radiations are picked up by specially designed radio equipment with great sensitivity. Messages are passed from one place to another through telephone lines, VHF links or satellite links. These messages are generally coded to avoid easy detection.

ELINT measures intercept these messages using highly sensitive receivers located near the country's borders or with the help of satellite monitors. These coded signals are then deciphered using decoders (similar to digital computers) and passed to specific users. Radars are operated round-the-clock to maintain watch on the intruding aircrafts or other weapon systems in the airspace. Such radars transmit short pulses of very high energy so as to collect reflected energy from intruding objects and display their image on the screen and further process it to confirm the identity.

During peace, the location and movement of troops as well as other characteristic features are collected and action plans made to counter the effectiveness of the enemy preparations. Electronically guided weapon systems, namely, surface-to-air, ship-borne and air-to-air missile guidance radars transmit their highly secretive operational frequencies for a very short duration during their scheduled inspection and maintenance checks. Such short transmissions are of immense importance. All sophisticated receiver systems fitted in satellites, or the AWAC type of aircraft, pick up these signals to analyse and predict the location, frequency and characteristics of the weapon systems.

A right type of signal picked up during peace time, thus helps the military planners in two ways. First, the enemy will not be able to take the country by surprise because the presence of the new weapon systems and their probable deployment is already known to its forces. Second, electronic countermeasures or other steps are undertaken well in advance to dilute their effectiveness.

ELINT measures are thus continuously undertaken during war and peace. Prior to outbreak of hostilities, these measures are enhanced to gather maximum information about the deployment of enemy forces and their plans for action. Superpowers are able to announce the nuclear explosions or the numbers of strategic missiles deployed only because of their foolproof ELINT systems supported with sophisticated data processing systems.

Electronic countermeasures

These are the means of interfering with the enemy's electromagnetic emissions. Such emissions use: (i) VHF and HF frequencies for communication, and (ii) microwaves for radio and radar applications, including navigation.

Communication links. Communication plays a significant role in the success or failure of war preparations and their execution. This is the means to convey the orders of the commanders to the subordinates and also to get feedback from the battlefields. Some of the means of communication in peace areas are:

1. Telephone lines
2. Telex lines
3. Microwave links
4. Postal delivery
5. Radio telephoney or radio telegraphy

In tactical areas, communication is basically dependent on radio links. If the distance between two stations falls within line of sight, VHF communication provides a reliable link. However, if the distance is longer, microwave link using troposcatter phenomenon or HF communication links are mostly used.

Troposcatter links are directional and operate at a very high power. Therefore, these links are difficult to jam by conventional means. But airborne jammers fitted to AWAC type of aircraft may be able to interfere with these links.

High frequency transreceivers provide communication links at a low cost. These transreceivers are operated by specially trained operators and communicate with one another using battery-operated portable sets. There are a large number of communication channels on each set and the operator can select different channels at different times so as to keep the enemy guessing. HF channels are usually noisy due to atmospheric disturbances and are not very reliable. Moreover, since the channels are not directional, the enemy can monitor such transmissions easily. The enemy can also transmit on the same frequency to create confusion and spread rumours or propaganda. There are not many ways to protect these links from enemy interference or jamming. Coded messages at various frequencies and at different times are usually used to prevent the enemy's interference on these links.

Radio and radar navigation links. Ships, aeroplanes or ground-based vehicles make use of radio waves for fixing their position in sea, air or on ground respectively. One of the techniques employed for this purpose is illustrated in Fig. 1. In this technique, A, B and C are three transmitters transmitting signals at specified frequencies and codes. The radio direction finder fitted in the weapon system is tuned to the respective frequencies of the three transmitters. The bearings with respect to each are noted. These bearings are plotted on a map on which the position of these beacons are pre-marked. These directions are shown by the lines AX, BY and CZ. The triangle made by the intersection gives the position of the ship, the aeroplane or the vehicle as the case may be. If the bearings are taken very accurately, the size of the triangle will be very small and the location of the object will be very accurately known.

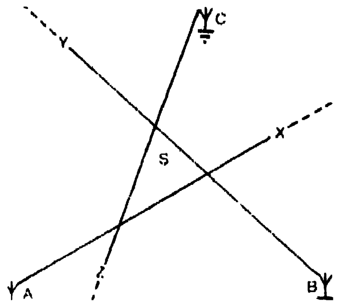


Fig. 1: One of the techniques used for radio and radar navigation links.

The enemy tries to confuse the user of these beacons by transmitting signals at the same frequency but from different locations. Thus, radio facilities cannot be used for navigation of ships, aeroplanes or ground vehicles.

Radars are also used for directing planes to their targets or destinations. Usually, a voice link between the pilot and ground control is maintained to control and guide the aeroplane. The location of the aeroplane is available to ground control on a plan position indicator (PPI) type of display (similar to the cathode ray tube used in TV screen). The echo from the aeroplane is plotted from instant to instant, either manually or by a digital processor, and is used by ground control to guide the pilot.

The enemy usually keeps a record of the radar characteristics used for guiding a country's pilots. During war, it is not unusual to find blocking of the PPI displays caused by the enemy ECM jammers. These jammers are specially designed with powerful transmitters sending pulses at the same pulse repetition frequencies at which an opponent's radars are operated. Fig. 2 illustrates the noise created by one such jammer on a PPI screen. In normal operations, the PPI screen comfortably identifies the reflected pulse (Fig. 3).

Missile guidance radars. Radars are also used for guiding surface-to-air or surface-to-surface missiles. The types of guidance used in both kinds of missiles is similar, except that the role played by each type of missile is different. In surface-to-air missile systems, a missile is fired from the ground to shoot down an aircraft. But in surface-to-surface missiles,

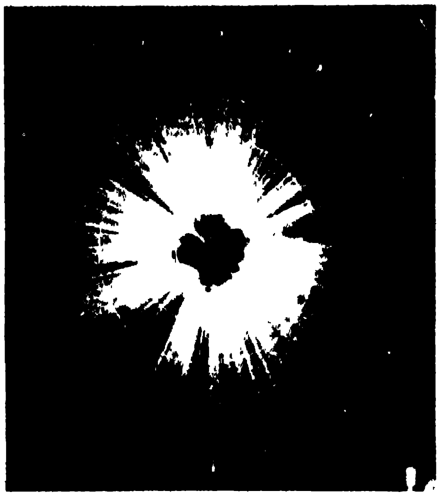


Fig. 2: Noise created by a jammer on a PPI screen.

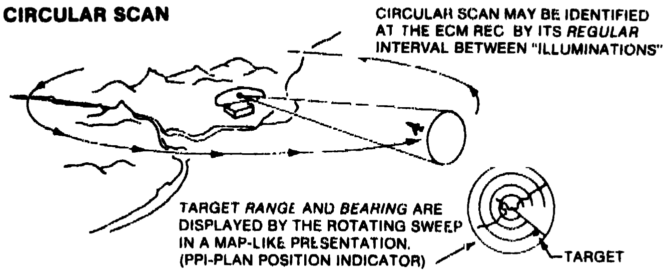

CIRCULAR SCAN
CIRCULAR SCAN MAY BE IDENTIFIED AT THE ECM REC BY ITS *REGULAR* INTERVAL BETWEEN "ILLUMINATIONS"
TARGET *RANGE* AND *BEARING* ARE DISPLAYED BY THE ROTATING SWEEP IN A MAP-LIKE PRESENTATION. (PPI-PLAN POSITION INDICATOR)
TARGET

Fig. 3: Identification of reflected pulses.

Brief History of Electronic Warfare

World war II saw the development and use of radar as a defensive tool. Both England and Germany worked simultaneously, each trying to gain advantage in the electronic battle for victory. Germany came up with chaff jamming [window]. Out of the struggle, the first electronic countermeasures [ECM] were crudely developed and used on a limited basis.

After the success of the British 'window' attack on Hamburg, an enraged Hitler ordered work to begin on the V-2. This rocket would eventually be used on London. V-2s were still a long way off, however, and in the meantime Germany had to come up with effective counter-measures to thwart the British. The British often succeeded in drawing the German night fighters to false targets, thus eliminating the danger of defensive techniques.

In the middle of 1943, German scientists were working on a new device which could effectively counter the British radar navigation device called HZS. In a short time, Germans were able to keep up an uninterrupted watch on all HZS radar sets.

In the spring of 1943, Britain developed more sophisticated jammers in the frequency range of 38 MHz to 42 MHz–the range of the VHF radios which the German night fighters carried. These devices were known as ABC devices. By the end of 1943, the British were capable of jamming almost all German radar sets.

During the Normandy attack by the British forces in 1944, an elaborate countermeasure screen was devised utilising a combination of jaming techniques and false invasion forces. Under a four-part programme, first the radar sites defending the French coasts were softened up, that is located and rendered inoperative. Then, on the actual day of the invasion, there was to be a false invasion force designed to draw the German defenders' attention away from the real invasion force. At this time German radar sets still in operation would be jammed.

When actual invasion of Normandy began on June 6, 1944, ECM devices were used to generate fake invasion from the spoof fleet, and streams of aircraft darted in over the coast on fake sorties drawing the German defenders away from the actual invasion area.

Most German anti-aircraft units were rendered useless by the ever-increasing sophistication of the jamming units employed by the British and the Americans. By May 8, 1945, the war in Europe came to an end. The secret war that Mr Winston Churchill had spoken of–the war whose battles were won and lost completely unknown to the general public–was the electronic war.

After World War II

The Korean war was a repeat of World War II as far as ECM was concerned. Recognising the need for sophisticated electronic warfare, the Russians developed radars for their jet aircrafts along with radar-controlled surface-to-air missiles. By 1966, most warfare over North Vietnam was electronically controlled with offensive aircraft moving under the cover of sophisticated ECM systems and defensive measures also being guided by electronics.

While Russians installed new surface-to-air guided weapons [SAGW] in Vietnam and the Middle East along the Suez Canal, the Americans armed the NATO forces with ECM, ECCM and every other effective electronic device.

ECM in the Middle East

Following the debacle of the six-day war, the Soviets supplied and trained Egyptians with the sophisticated missile systems such as SA3s, SA6s and SA7s incorporating the best EW measures.

Caught unprepared by the new defensive capabilities, Israelis modified their tactics and came back at Arabs. With both Israel and Egypt operating on the same frequencies, missiles from both sides became degraded–losing their ability to respond to commands. Subsequently, Egyptian missiles shot down some of its own aircraft while missiles launched by Israeli aircraft sometimes ended up downing their own planes–another EW first!

missiles are guided to destroy an area on the ground.

Missiles are guided to the target by any one of the following methods:

1. Active homing guidance
2. Semi-active homing guidance
3. Passive homing guidance

In active homing (Fig. 4), radar A transmits powerful radio pulses in the direction of the target. Reflected signals from the target are picked up and processed to determine the range and bearings of the target. These parameters are then fed to another radar B called missile guidance radar. This radar is also used to track the target and guide the missile to it using radio commands for guidance and for detonation of missile guidance and control systems. Both the search radar A and the missile guidance radar B are operated at different frequency bands to overcome mutual interference.

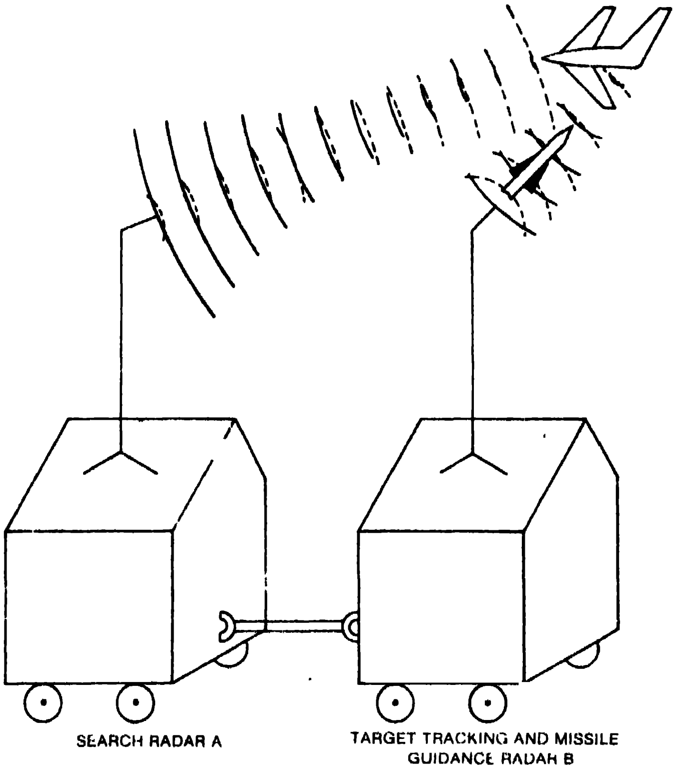


Fig. 4: An active homing radar.

In order to prevent any of these radars from guiding the missiles, airborne targets are fitted with ECM equipment. Such ECM jammers transmit radar frequencies of the same characteristics as the original transmissions made by the radars. This powerful transmission saturates the radar receivers and cripples their capability to search and guide.

In the semi-active guidance method, the ground radar A illuminates the target (Fig. 5) using powerful radar beams. The missile system has a receiver in its tip and homes on to the target by riding on this beam and collecting reflected signals from the target. Once again, ECM devices carried by the airborne targets disable the missile guidance system by transmitting false radio transmissions.

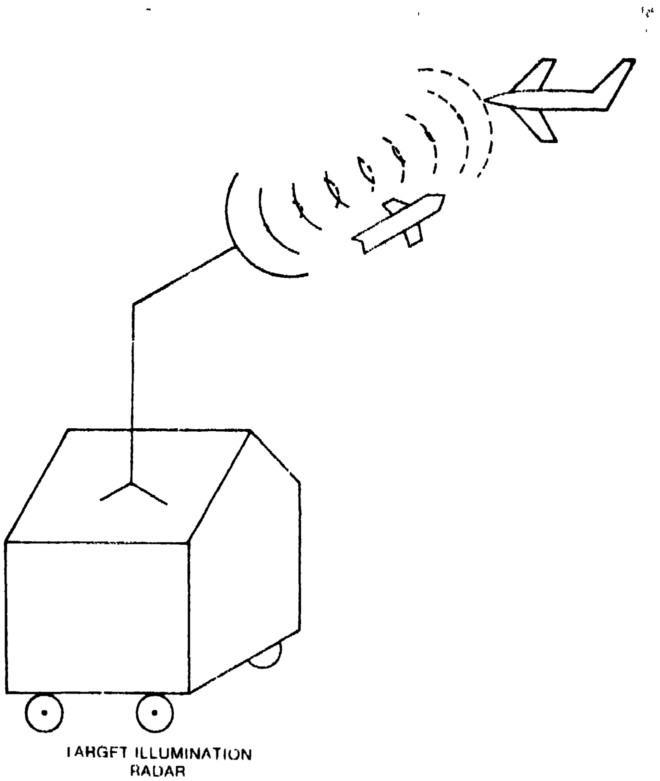


Fig. 5: Semi-active guidance method.

In the passive homing guidance method, missiles home on to a target by picking signals coming from the source. For example, a missile with infrared guidance devices homes on to the flares emitted by the engine of the aircraft.

A missile carried by the airborne weapon may launch a

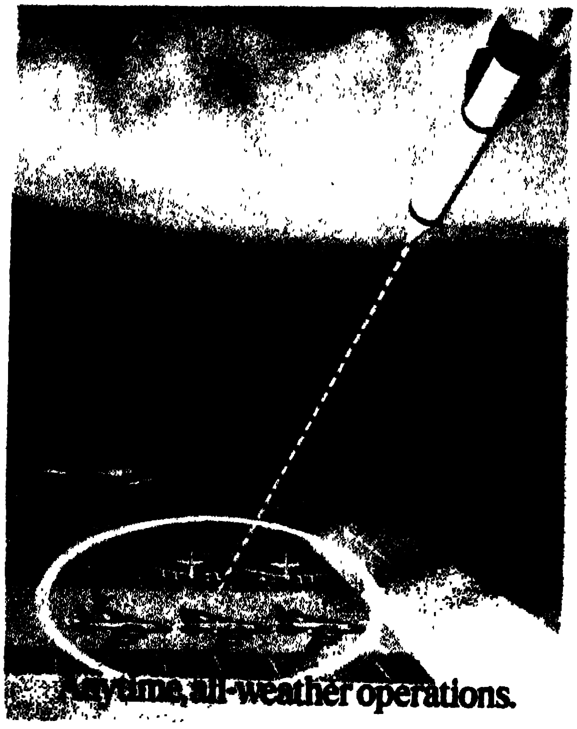

Anytime, all-weather operations.

Fig. 6: Passive homing guidance method.

missile to home on to the radar beam of the ground station as shown in Fig. 6. Here, the homing system fitted in the missile collects signals from the transmission of the ground radar and takes the guidance path by riding on this beam.

Classification of ECM

Electronic countermeasures can be broadly classified into passive jamming measures and active jamming measures. Active jammers are further classified as noise jammers and deceptive jammers.

Passive jammers. These jammers do not use any transmitter to jam the victim radar. Instead, they reflect the incident radar beam to give an image of a real target. Such jammers are made up of bundles of thin aluminium strips thrown from an aircraft. These strips disperse in the atmosphere and reflect the radar beam.

Corner reflectors are also used as passive jammers. These are simple mechanical devices which strengthen the energy reflected by a drone (unmanned) aircraft and guided by another aircraft in the air. Such jammers produce multiple echoes on the plan position indicator (PPI) of the radar and confuse the operators.

In another method, an ECM transmitter on board a hostile aircraft sends out, at intervals, a series of pulses of the same frequency and width as that of the detecting radar. These pulses give a number of echoes at different ranges on the radar receiver. Such a jammer creates an impression that large-scale air attack is being launched. In confusion, the enemy may empty his arsenal on false targets (Fig. 7).

Active ECM. These devices generate electromagnetic radiations to interfere with the enemy radio and radar systems. One such device is spark jammer wherein a spark type of noise is created at lower frequencies to jam communication channels. This is similar to the noise heard on a radio or TV receiver whenever a vehicle using spark plug passes in its vicinity.

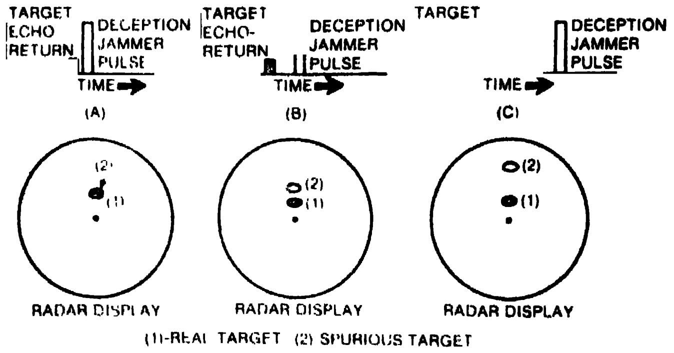


Fig. 7: The passive jammer method.

Sweep-through jammer is another active jammer which carries out saturation of radar receiver or radio receiver by sweeping the transmitter carrier frequency back and forth over a portion of the radio spectrum several hundred times per second. In this method, much lesser power of the jammer is needed to jam the victim radar or radio station.

Deceptive jammers. These devices are either manipulative, where friendly emissions are altered or simulated to mislead the enemy, or imitative where false information is introduced into the enemy receivers by imitating its signals.

One method to overcome these jammers is to use highly directional antennae and to employ frequency agility. Another method is to code the radar transmissions and decode the reflected echoes. This makes deceptive jamming much more difficult if not impossible.

Electronic counter countermeasures (ECCM)

These are the special devices adopted to reduce the effects of ECM activities of the enemy. These devices are classified as anti-active jamming measures and anti-passive jamming measures. Anti-active jamming measures are further classified as anti-noise jammers and anti-deceptive jammers.

Anti-noise jammer. One of the methods followed to counter noise jammer is to continuously vary radar transmitter frequency and its pulse repetition frequency (PRF). This is also known as frequency agility. Jamming under frequency agile condition of operation of a radar system is much more difficult, specially when the radar varies its frequencies at random.

Anti-passive jammers. Passive jammers like aluminium foils (known as chaff) lose their velocity once launched from the aircraft. Moving target indicators (MTI) are specially designed radar indicators which filter out echoes from stationary or nearly still targets. Thus speeding targets are detected and identified.

Some advanced designs in modern radars employ CW techniques in place of pulse techniques to counter the active or passive ECM techniques.

Interfacing with computers

Figs 8 and 9 illustrate the various electronic devices fitted on a ship and an aircraft respectively. These devices cover a very wide range of frequency and make it manually impossible to detect and react to electronic environment correctly and quickly.

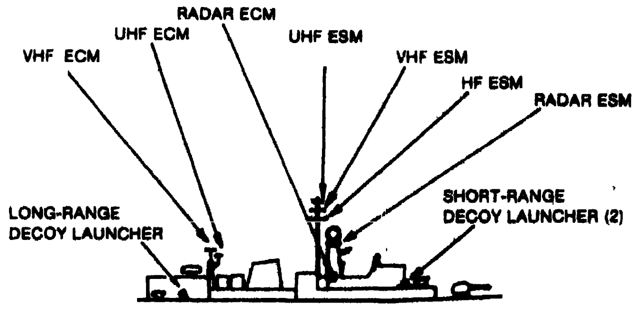
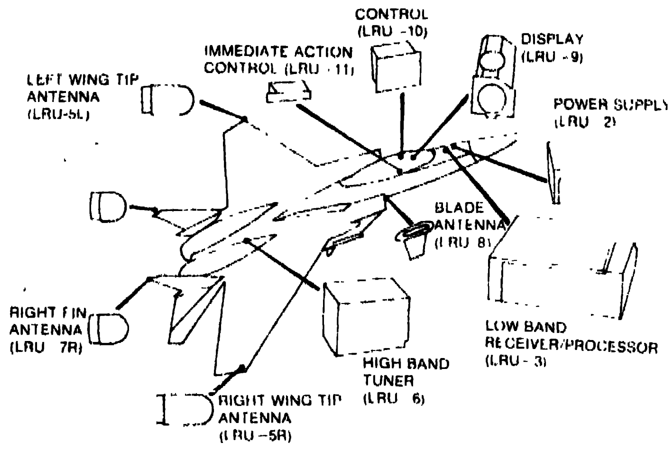


Fig. 8: Electronic devices fitted on a ship.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RIGHT FIN ANTENNA (LRU 7R)
LOW BAND RECEIVER/PROCESSOR (LRU - 3)
HIGH BAND TUNER (LRU 6)
RIGHT WING TIP ANTENNA (LRU -5R)

Fig. 9: Electronic devices fitted on a plane.

The block diagram of a simple computer-controlled ECM management system is given in Fig. 10. Signals emitted by the enemy's electronic systems are searched and detected using electronic detectors carried by either the aircraft or by specially designed ships. Electronic signals are processed and identified by special softwares developed for this purpose. These are displayed on the consoles for visual display to the ECM commander.

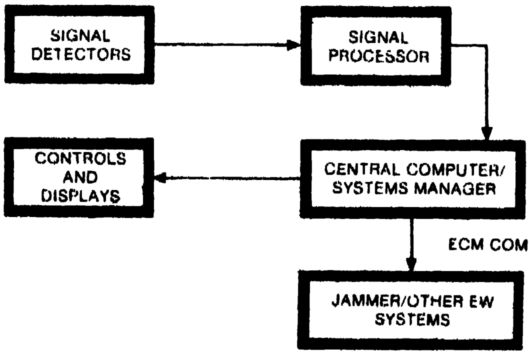

Fig. 10: Block-diagram of a simple computer-controlled ECM management system.

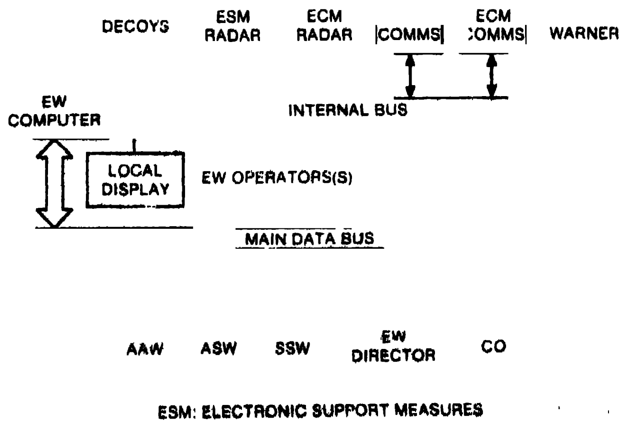

Fig. 11: Integrated electronic warfare suite.

Based on the decisions taken by the commanders, ECM commands are generated and jammers are activated to dilute or nullify the hostile electronic environment. The time available for search, identification, acquisition and lock on to signals may be as short as 60 seconds. Therefore, EW commanders have to be constantly on the alert.

ECM weapons now being built are small in size but their cost is escalating as more and more sophistication is introduced in each of these systems. Fig. 11 illustrates an integrated electronic warfare suite adopted in the present-day context.

Conclusion

Electronic warfare activities normally flare up just before the beginning of hostilities but preparations continue all the time. During peace time, the only defence against enemy violation of airspace or sea territory is the ECM measures.

If an enemy aircraft intrudes into one's airspace to collect data on weapon systems, the best step is to jam its receivers rather than shoot it down which may create tension.

To quote an expert on ECM, "It is a truism to say that not one day passes in the ECM industry without some new development, or a major adoption of an old one. Some of the modern techniques being developed are so complex and require such vast amounts of money, and expertise, that it is inevitable that some time lag in development will exist on both sides. In the end, however, it is the country that develops its potential for the secret war to the fullest, that will come out ahead—if indeed it can be said that any country came out ahead in any war." □

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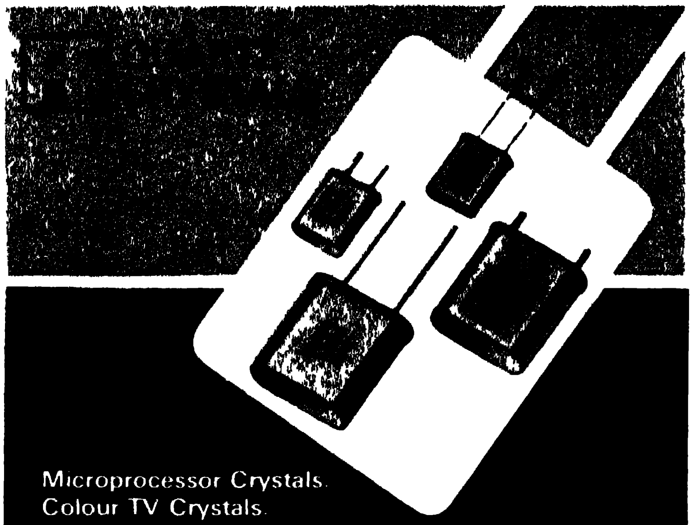

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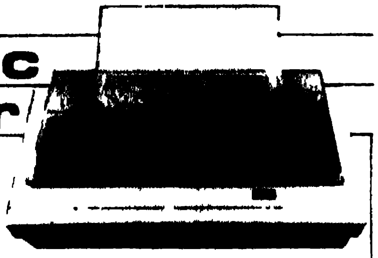

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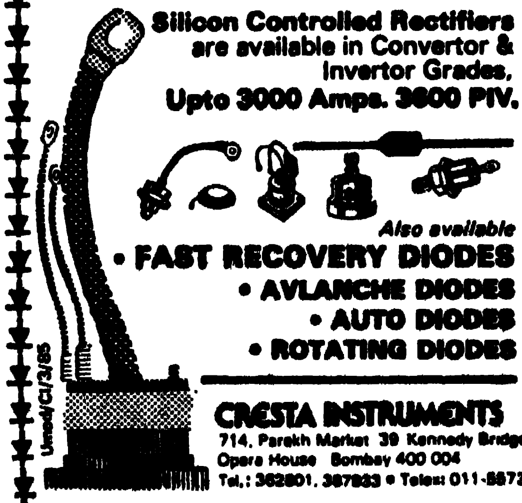

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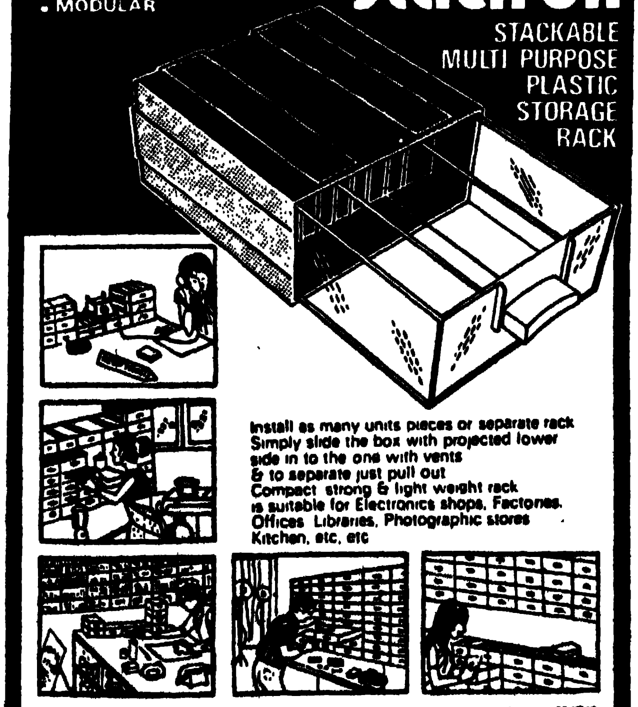

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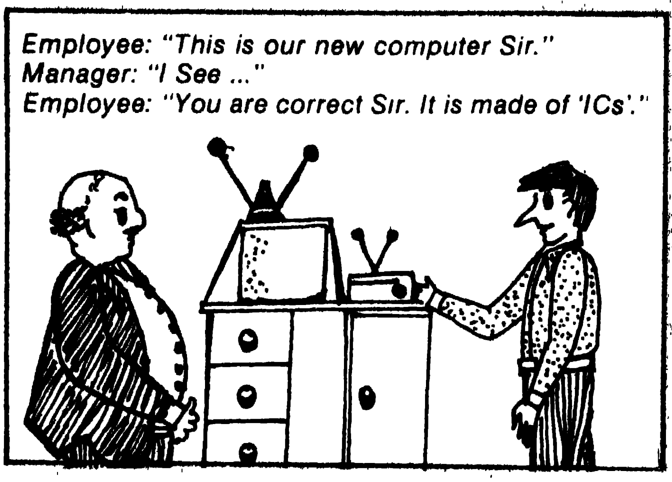
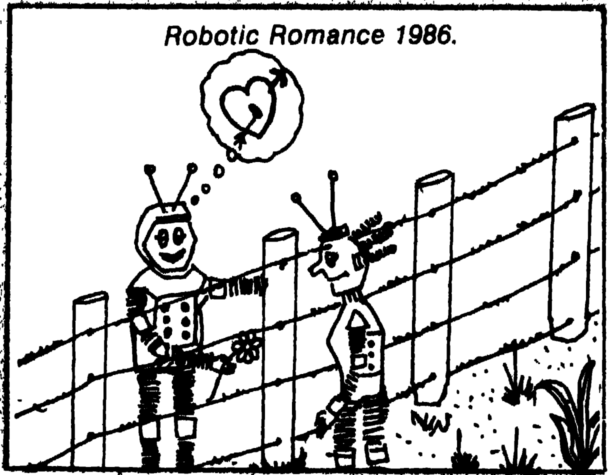

Employee: "This is our new computer Sir."
Manager: "I See ..."
Employee: "You are correct Sir. It is made of 'ICs'."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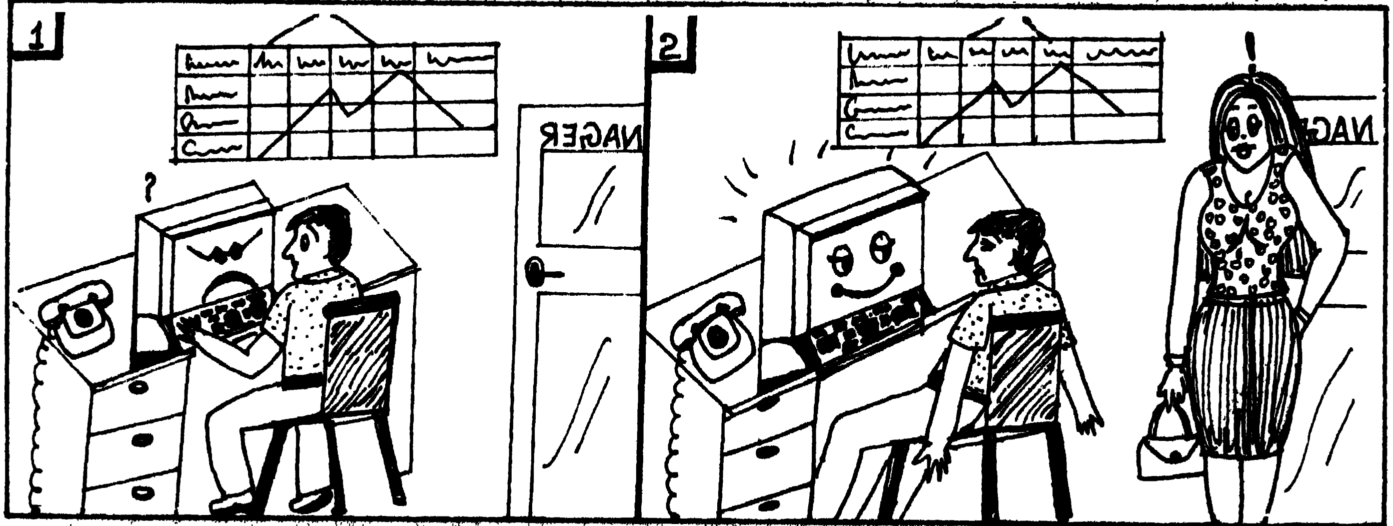
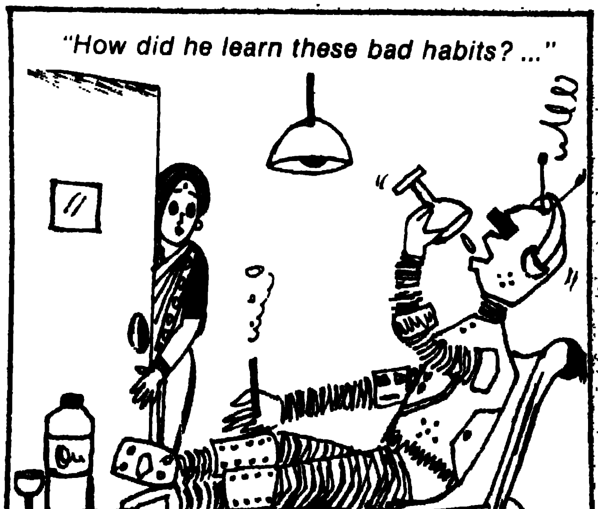
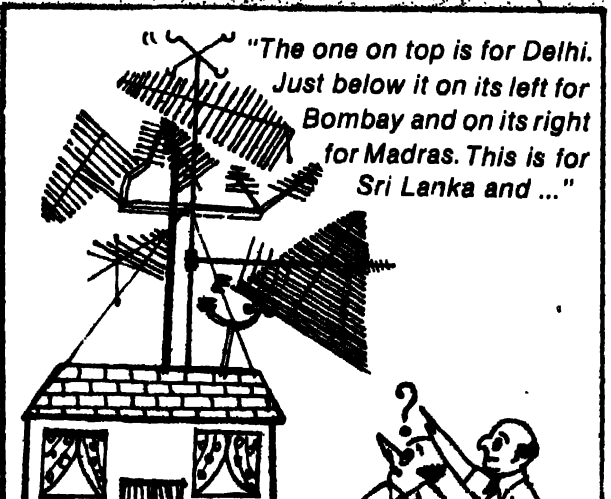



"How did he learn these bad habits? ..."


"The one on top is for Delhi. Just below it on its left for Bombay and on its right for Madras. This is for Sri Lanka and ..."

A Game of Steady Hands

Bidyut Chakraborty

Somebody defined the word 'sober' in following words: "If I am drunk and I think I am drunk, then I am sober. But if I am drunk and I think I am sober, then I am drunk." A wonderful labrinth of words! So far as I am concerned, this definition helps me (I don't loose anything to say that I am sober, i.e., drunk). But how to know about a third person's state of sobriety or drunkeness after, say, a gala party? Being electronically biased, we ought to find some electronic solution to the problem of measuring soberness. Here we go!

Let me avail of this opportunity to put forth a new formula for soberness. (Of course, I won't prove it !)

$$\text{Percentage of soberness} = k \frac{n}{1-n} \times S$$

where, k = a constant
n = clever factor (< 1)
S = steady factor

Whereas, n is fixed for each human being (and tends to unity in direct proportion to the affection between one measured and other measuring), k is a constant (taken as 1 for tropical conditions); S the steady factor, varies with individual capacity of consumption.

This circuit will help you measure 'S' by four factors—0.05, 0.1, 0.5 and 1. Hence, if your n = 0.99 (sure?) and S is 1; then you are $\frac{0.99}{1-0.99} \times 1 = 99\%$ sober! Well this is the limit, you cannot be more sober.

The game

So much about the introduction. Now, let us talk about the game. Let me warn you here! A good (I repeat 'good') skill is required to prepare this module. So far as the electronic part is concerned, you can jump at it with your n = 0.5 and above, but there is a good deal of craftsmanship involved in it which is not at all electronic. In fact, this latter

---

Mr B. Chakraborty is senior programmer, EDP centre, Bokaro Steel Plant.

PARTS LIST

Semiconductors:	
IC1	NE555 timer
IC2	CD4016 quad analogue switches
D1-D5	1N4001 rectifier diode
D6	5mm light-emitting diode
Resistors (all ¼ watts, ±5% Carbon):	
R1	82-kilohm
R2	18-kilohm
R3	33-kilohm
R5	120-kilohm
R6	10-kilohm
R7	820-ohm
R8	2.2-kilohm
R4	22-kilohm
Capacitors:	
C1	0.015µF, ceramic disc
C2	10µF, 10V electrolytic
C3	0.01µF, ceramic disc
Miscellaneous:	
LS	8-ohm loudspeaker
	aluminium rods, aluminium angles,
	IC sockets, PCB, enclosure and hardwares etc

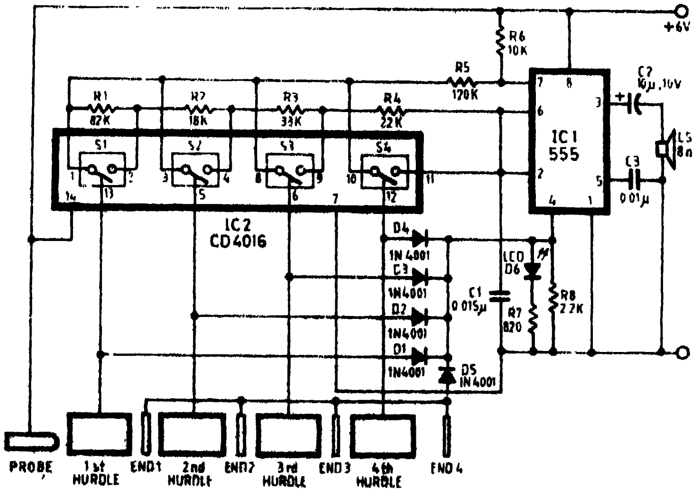


Fig. 1: Circuit diagram for the game of steady hands.

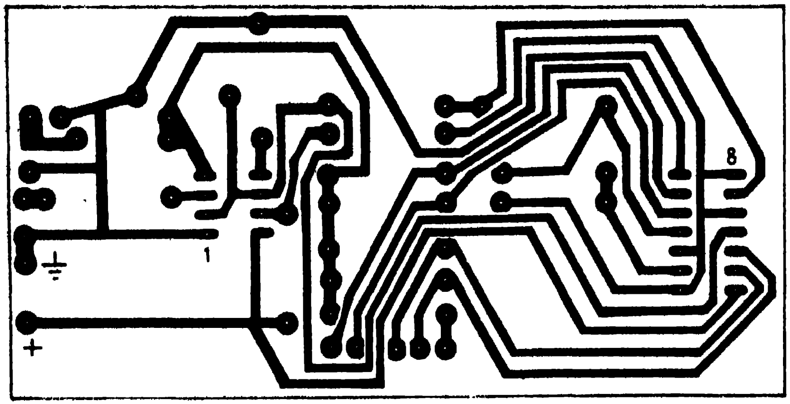


Fig. 2: PCB layout for the circuit.

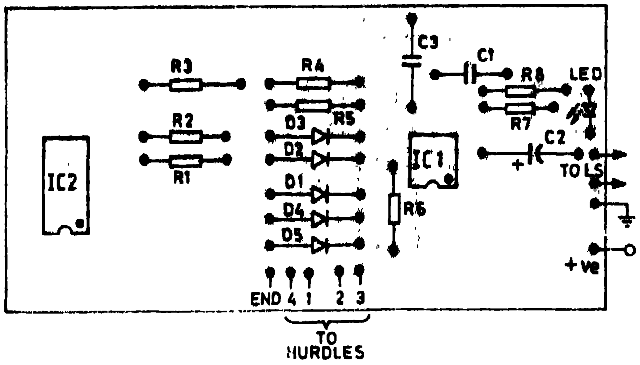


Fig. 3: Component layout for the PCB.

part is the thing that really matters. The electronic part gives only the audio measure of the steadiness factor achieved.

Let us start now. This is somewhat similar to the age-old steady hand testing game with, of course, a bit of improvement. There are four test sectors in it, each being more difficult than the other successively. Then, there are stoppers, called end sectors, to recognise the win of each sector. (These sectors or hurdles will tickle your imagination of course, if you don't copy the ones given here). A probe has to be passed through these sectors. Whenever an unsteady hand lets the probe touch any of these sectors, an audio-visual signal announces the failure. The pitch of the audio signal (well, of course not the visual one) increases with the degree of complexity of each sector. The end sectors give the lowest pitch, announcing the win.

The circuit

The electronic part of the project is an oscillator built around IC 555. The reset pin 4 of 555, is not connected directly to the positive bus. Rather, it is connected to ground through R8 on one hand and to the sectors on the other hand. There is a probe, connected to the positive of the supply which has to be passed through the sectors. Whenever the probe touches any of the sectors, the positive rail of the supply is applied to the pin 4 of IC1 (555) via D1 to D4 and it starts oscillating.

The frequency of this oscillation, and hence the output tone, is controlled by the resistors R1 through R5 between pins 6 and 7 of 555. Analogue switches, S1 to S4 (in IC2 CD 4016) are connected across the resistors R1 to R4 in a manner such that S1, when operated, shorts R1, S2 shorts both R1 and R2 and so on. Thus, by activating switches S1, S2 etc the effective resistance between pins 6 and 7 of 555 is reduced. The control pins of the switches are connected to the four sectors of the model. Thus, whenever the probe touches the sectors, a control voltage is applied to the corresponding switch, and it is activated. The combination of sectors, switches and resistances is arranged in such a way that the frequency of the output increases with the complexity of the sectors.

The circuit can be easily assembled on a veroboard. But if desired, a small PCB can also be made. PCB layout is given in Fig. 2 and the component layout in Fig. 3.

The sectors

The construction of the typical sectors is given in Fig. 4. This part of the model requires skillful handling. The skill required to play this game depends on how this part is made. The end sectors being the stoppers of individual sectors, recognise the neat job with a particular tone. The failures are recognised by other tones which vary with each sector.

Two types of hurdles are proposed in Fig. 4. One with

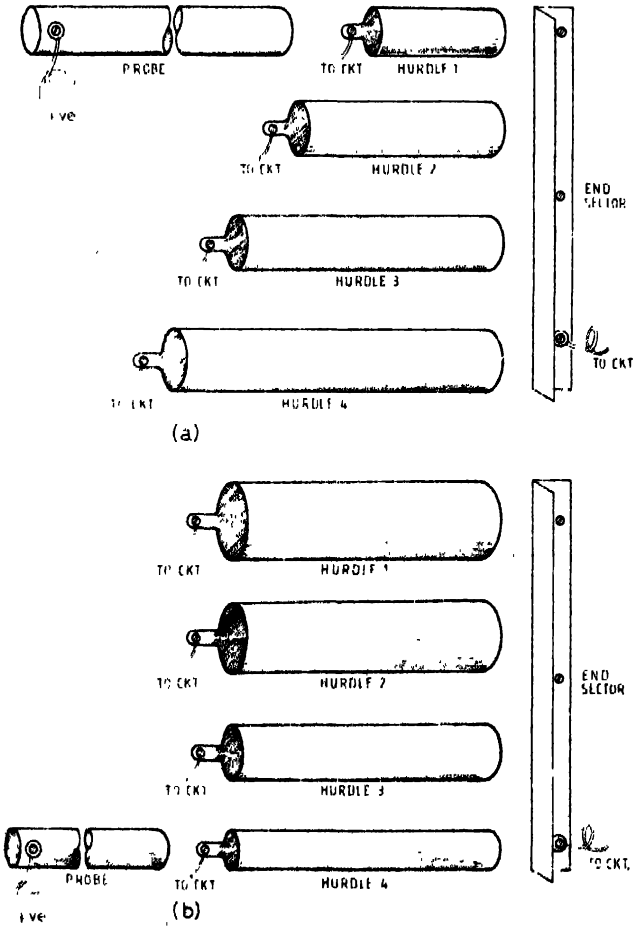


Fig. 4: Schematic showing the construction of typical sectors.

reducing diameter and same length and the other with increasing length and same diameter. The probe and hurdles are made of aluminium rods. The probe just passes through the thinnest sectors. Another variety is to connect the end sectors with switches and the hurdles with a fixed tone point. Thus with every win, we will get different tones. And then, you may use your imagination for more varieties.

Guidelines

Lastly a wood about how to play the game. Using your own discretion, allow a few failures in each sector. Say one failure in first sector, two failures in the second and so on. Give following marks (steady factors) for each stopper:

1st stopper = 0.05
2nd stopper = 0.05
3rd stopper = 0.4
4th stopper = 0.5

Thus, if first sector is completed, steady factor is 0.05, after the second it becomes 0.1 (0.05 + 0.05), after the third it is 0.5 (0.1 + 0.4) and after the fourth it is 1 (0.5 + 0.5). Then use the formula if you like. If not, just add points and decide the winner. Alternatively, give points to the failures. Four points for each failure in first sector, three points for second and so on. Then, add all points. The winner is with least number of 'failure' points.

Wish you a steady game.... ☐

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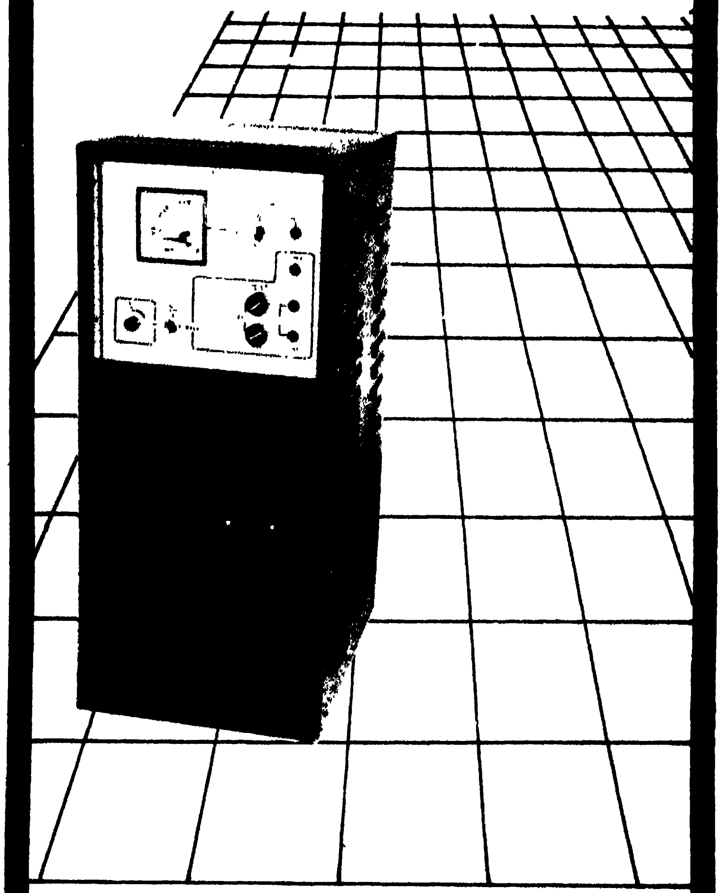

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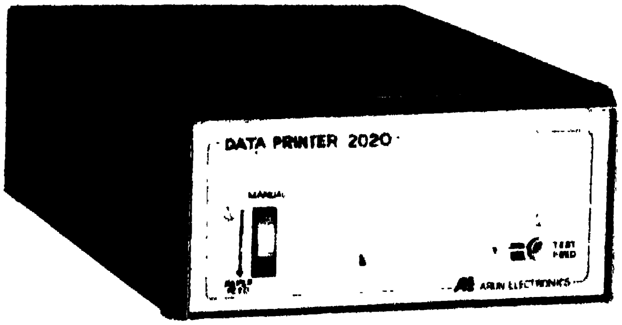

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Quick 741 and 555 Tester

Anupam Saurabh

Gone are the days when the ICs 741 and timer 555 were rare and expensive. Now these are the most frequently used ICs, even by an average hobbyist. These are very versatile and damage-resistant.

The tester described here tests both these ICs instantly and uses only a few resistors, switches, sockets and capacitors which cost only about Rs 20, excluding the PCB and the 7-segment display. This tester is equally useful for a shop or a factory.

Circuit description

As evident from the circuit diagram in Fig. 1, the heart of this tester is the astable multivibrator formed around IC 555 with approximately 2 Hz frequency. So, the output LED D1 (as shown in Fig. 2) blinks at a rate of 2 Hz if the IC 555 inserted in the socket works well.

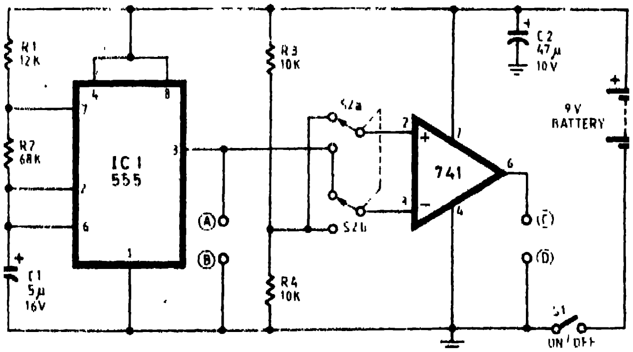

Fig. 1: Circuit diagram of 741 and 555 tester.

PARTS LIST

Semiconductors:	
IC1	555 timer
IC2	741 op-amp
D1, D2	5mm light emitting diode
DIS1	FND507/LT542 Common anode display
Resistors (all ¼ watt, ±5% carbon):	
R1	12-kilohm
R2	68-kilohm
R3, R4	10-kilohm
R5-R12	1-kilohm
Capacitors:	
C1	5μF, 16V electrolytic
C2	47μF, 10V electrolytic
Miscellaneous:	
S1	On/off toggle switch
S2	DPDT miniature switch for mounting on PCB
BATT.	9-volt, battery
	IC sockets, PCB, connecting wires,
	enclosure, hardware etc

This output at pin 3 is also given through a DPDT switch to the pins 2 and 3 of IC 741 op-amp. The switch S2 selects the inverting or non-inverting input of the IC2. In this way the LED D2 (Fig. 2) also blinks at a 2Hz rate if the IC2 (741) inserted is OK.

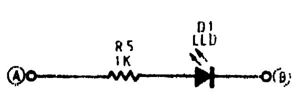

Fig. 2: Optional two LED display.

If S2 selects inverting mode, then D1 and D2 blink alternately and if S2 selects non-inverting mode then D1 and D2 blink simultaneously.

You may use 3V to 12V DC supply voltage safely. However, 9V DC is recommended.

Optional

As an interesting feature which gives a digital display without any confusion, you may use a common anode seven segment display. With IC2 in inverting mode, the display shows 7 and 5 alternately. In the non-inverting mode it shows 9 and _, alternately.

Both, the two LEDs and digital display options are given in Fig. 2 and Fig. 3 respectively.

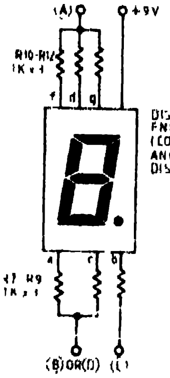

Fig. 3(a): Digital display using common anode seven-segment display.

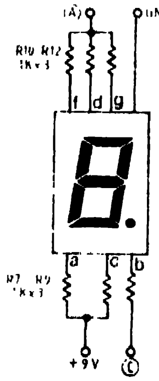

Fig. 3(b): Digital display using common cathode seven-segment display.

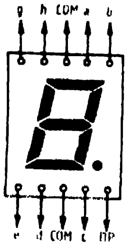

Fig. 4: Pin configuration of seven-segment display.

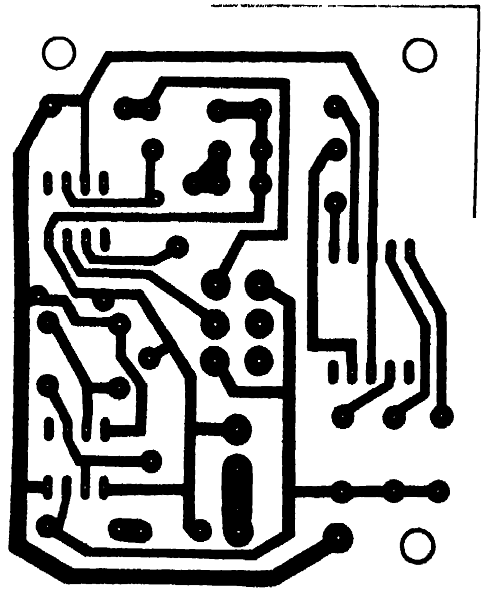

Fig. 5: PCB layout for the circuit.

You may use a common anode display having a damaged decimal dot and/or segment 'e' which are not used here. You may also use a common cathode display here by just interchanging the connections of common cathode from positive to the negative of the supply on the PCB (see Fig. 5) near the switch S2. Similarly, interchange the connections of R7 and R8 from negative to positive of the supply as shown in Fig. 3(b).

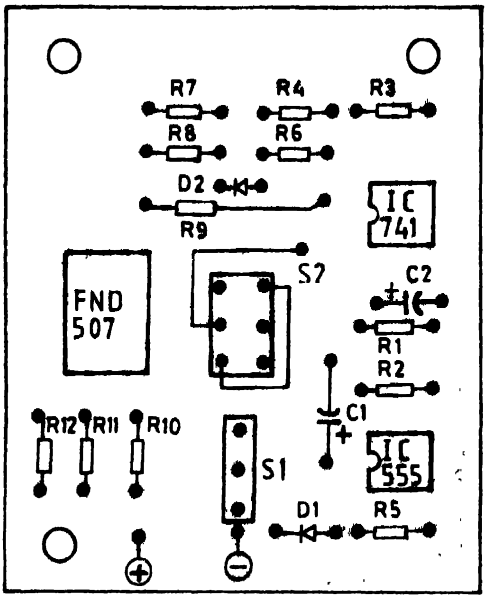

Fig. 6: Component layout for the PCB.

Testing

Put a new set of 741 and 555 and see on display the figures 7 — 5 and 9 — 7 at the flip of switch S2. The display blinks (shows 5 and ˉ, even in absence of 741) only if the IC 555 is OK. Anything else blinking on display implies a faulty IC 741. So keep a set of good ICs on board. Keeping one IC as good one, you can test the other type of ICs.

LAB NOTE: It has been noted that when both IC 741 and 555 are faulty or in non-operating condition, the display shows ˉ, (but there is no change in the display while changing the switch S2), and when IC 555 is working and 741 is in non-operating condition the display shows 5 and ˉ, alternately and when IC 555 is not working but 741 is alright, then display shows 7 in inverting mode and ˉ, in non-inverting mode, but does not flash. □

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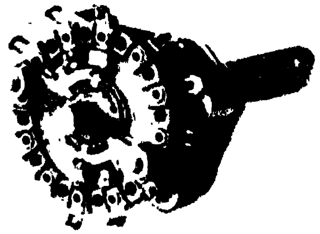

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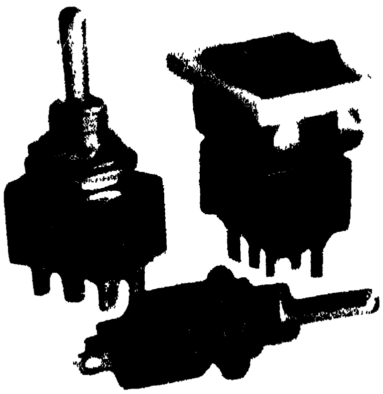

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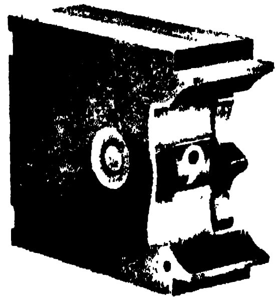

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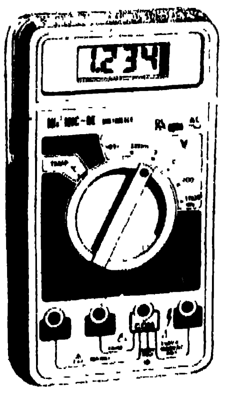

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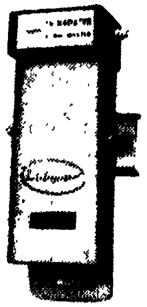

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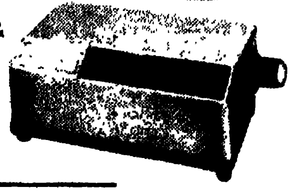

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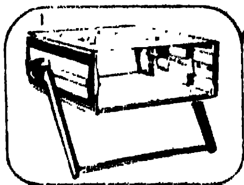
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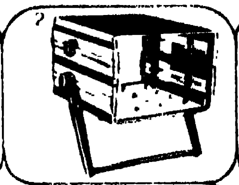
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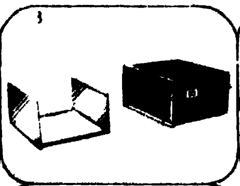
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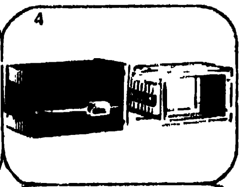
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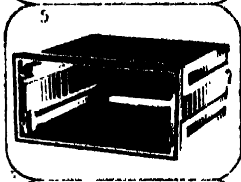
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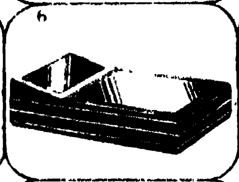
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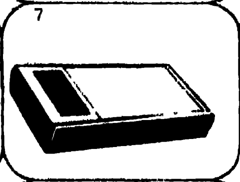
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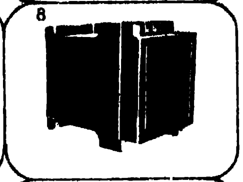
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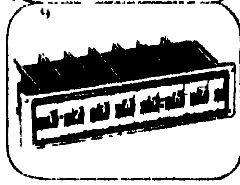
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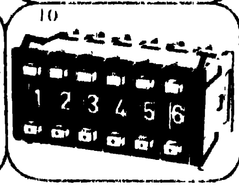
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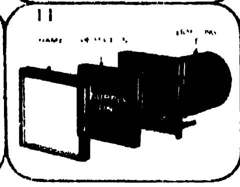
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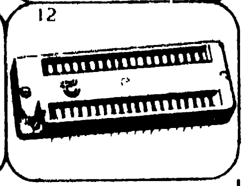
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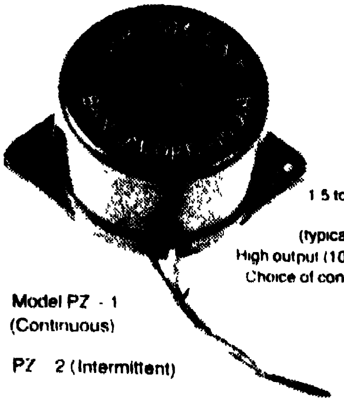

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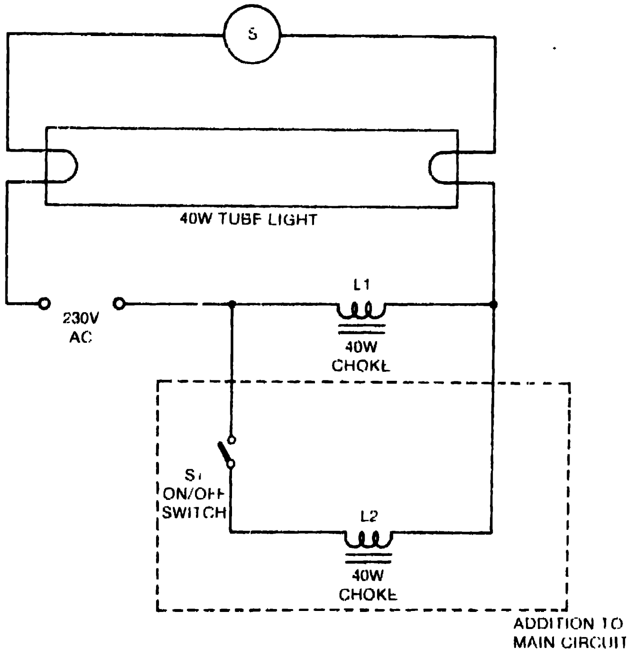
Troublesome Tubelight

Tubelights can be very troublesome at times. They flicker on and on but refuse to glow. One may find to his surprise that while this is the case with his tubelight, his neighbour's tubelight in another apartment of the same block is functioning quite well.

The problem is more prevalent in the evenings and is easily traceable to voltage fluctuations. The tube works well at the normal voltage of 220V but flickers when it drops to, say 170V, while others' tubes work well even at this reduced supply voltage. Replacing the tubelight and choke with new ones does not end the trouble. There is still one way out of the dilemma and to make your tubelight glow even at 170 V. This circuit explains just that.



The actual circuit of the tubelight is shown in figure. Now make a small modification. Add one additional choke of the same rating (i.e., 40W) in parallel to the existing one through an on/off switch (bed light switch type). The modified circuit (after adding an additional choke) is also shown in the circuit as the dotted box.

The following points should be kept in mind:

1. The additional switch connected should be operated only when there is drop in voltage and the tube is flickering.
2. If the voltage fluctuation persists keep the switch 'on' till such time as the voltage is constant at 220 V.
3. The second choke can be mounted either on the base of the tubelight itself or fixed separately.

Some tubes flicker even at 180/195 V. This is due to the age of the tube and the choke and also due to different choke standards. The above circuit has been tested successfully with a 36-watt slim Philips tube.

A. SUBRAHMANYAM

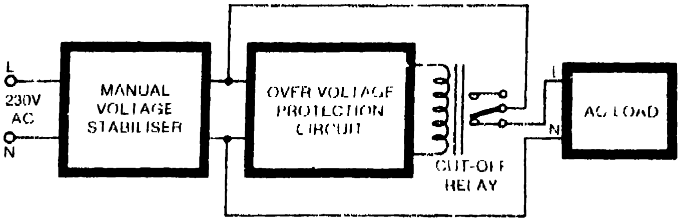
Overvoltage Cutout Using IC 723

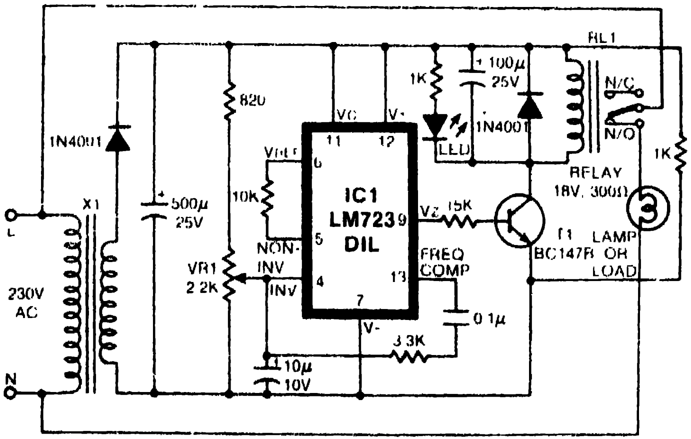
Yes, the circuit uses the popular voltage regulator chip IC 723, as an overvoltage cutout. The 723 contains all the essential components a stable reference voltage (7.15 volts), a comparator etc required for an accurate cutout circuit. Thus, with a handful of other components, you can protect your expensive items such as VCRs, stereo systems, televisions, etc from damage due to overvoltage.

The circuit can be used after a stepup/down manual voltage stabiliser (see block diagram). It can also be used without the stabiliser -for this the transformer is connected directly to the mains. Of course, in this method, you will have to wait for the mains supply to reduce before the item can operate again.

The reference voltage is connected to the non-inverting terminal of the comparator. Through a potential divider arrangement, voltage is fed to the inverting terminal. Normally the voltage at the inverting terminal is set such that it is less than that at the non-inverting terminal The output at Vz (pin 9) is high, saturating the transistor T1. The relay operates and power is connected to the protected mains equipment.

When the mains voltage rises above the pre-set (safe) limit,





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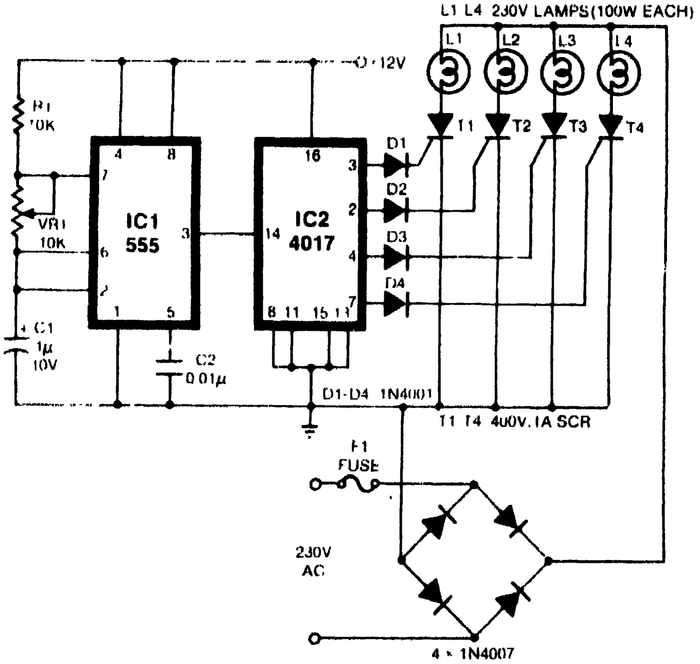
non-inverting terminal and the output of the comparator swings to ground. The transistor T1 cuts off, and the relay becomes inoperative disconnecting supply to the unit. When the mains voltage is reduced, using the manual stabiliser, the reverse procedure occurs, and power is restored.

The maximum 'safe' voltage is set using the manual stabiliser. The preset VR1 is adjusted so that the relay just cuts off when the safe limit (say, 225 volts) is exceeded. Repeat till accurate setting is achieved.

VIVEK MEHRA

Running Light Effect

Even today some persons produce running light effect by the use of rotter along with the expensive electric motor. Here is a circuit for producing running light effect which may cost approximately Rs 80 to assemble.



This project consists IC 555, CD4017 and four SCRs which are connected as shown in circuit diagram. IC 555 is used as an astable multivibrator. It produces clock pulses which are given to decade counter IC CD4017. Frequency of clock pulses can be varied by potentiometer VR1. When clock pulses are applied to decade counter, T1 to T4 trigger in sequential manner producing running light effect.

When one of the SCRs is continuously in operating state disconnect high tension power supply intermittently.

Lab Note: If more than four lamps are required repeat the circuit of D1 to D4 and T1 to T4 connected to pins 10, 1, 5, 6, 9, 11 and 12 as per the number of lamps required (max.10 Lamps). For continuous running light effect without any interruption between the two successive runs, simply connect pin 10 of CD4017 to pin 15 instead of direct ground. To vary the running speed beyond the control of VR1, change the value of capacitor C1 to more than 4.7μF to slow down, and less than 1μF to speed up.

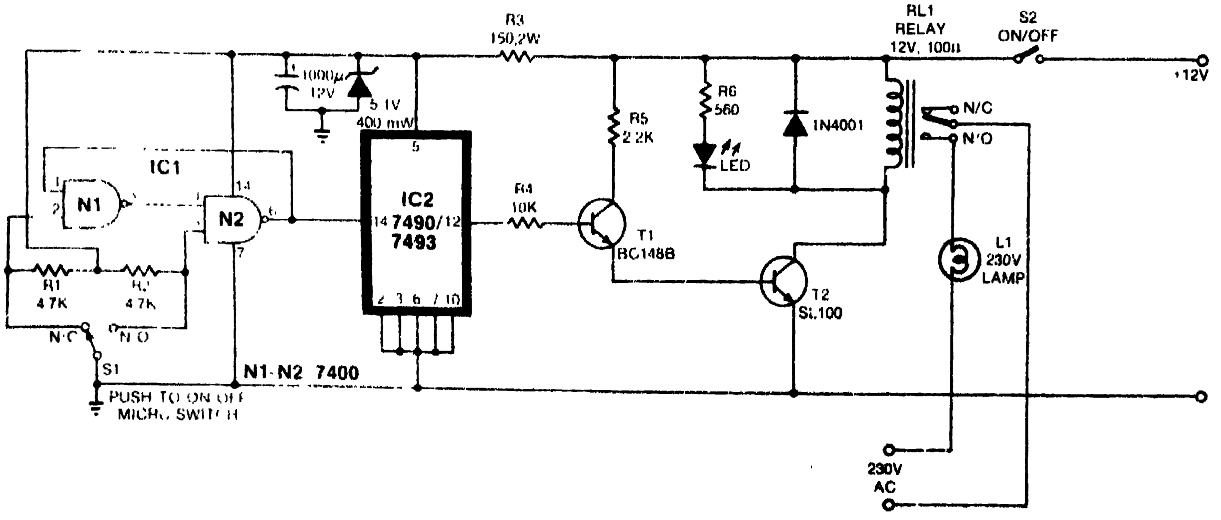
PROF. R.V. DHEKALE

Automatic Bathroom/Toilet Light

When the bathroom/toilet door is opened, this automatic light switches itself on. Even after the door is closed from the inside, the light continues to glow and does not go off till such time as the door is opened to come out. The light switches itself off when the door is closed from the outside and stays that way till the door is opened again to go inside. Further, an LED on the door indicates the presence of a person inside the bathroom.

Fix the switch S1 in such a way that while opening the door for going in or coming out, it gets connected with N/C contact and while closing the door it gets connected with N/O contact.

IC1 (7400) gives debouncing pulse from switch S1 to input of IC2 (7493). When 7493 gets the first pulse its output becomes '1' and transistors T1 and T2 drive relay 'on'. After receiving the second pulse 7493 output becomes '0' and relay gets 'off'. The LED which is used as an indicator, is kept



parallel to the relay and gets 'on' or 'off' simultaneously with the relay.

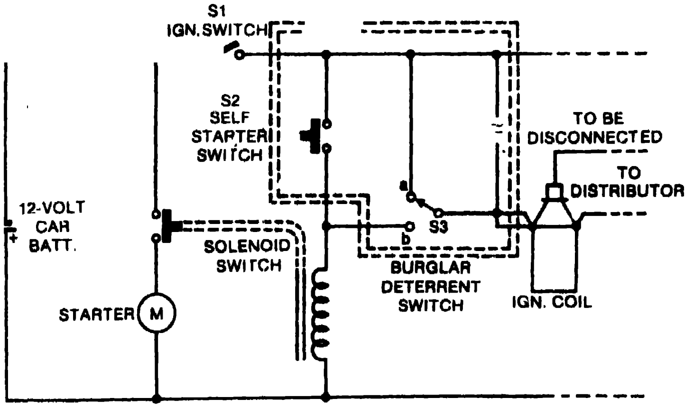
Before starting this circuit, the door is kept open to supply the power through switch S2 and then closed from the inside and the circuit is ready to work. This circuit is inexpensive as it consists of only a few components which are easily available.

I.A. GODHRAWALA

Car Burglar Deterrent

Most of the CBDs (car burglar deterrents) either disable the ignition system or sound an alarm when an attempt is made by unauthorised persons to operate the car. This version is a variation on the above theme and while disabling the ignition it gives an impression of a malady of a different kind.

Simple addition of throwover switch S3 with the connected wiring, shown in the dotted box in circuit diagram, is about all that is required to be done. Needless to say that a bit of imagination is required to conceal the switch S3 from the prying eyes of the intruder. All this can hardly be called electronics though. In the normal position 'a' of the switch, the car engine works normally. However, when the switch S3 is thrown to position 'b' the ignition coil gets its power supply along with that of the self-starter solenoid.



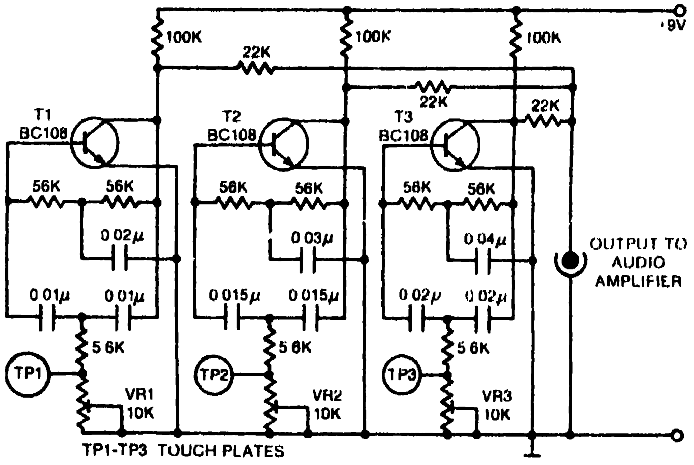
As a result, the engine fires and runs so long as the self-starter switch is kept on and stops as soon as it is released. In short, the engine exhibits symptoms of carburettor starvation! This should dissuade the not-so-insistent intruder to look for any trouble in the ignition system, including any concealed switch. Any attempt to connect the ignition coil directly to the battery will, on the other hand, result in cranking of the engine etc, making it unsafe for the intruder. Inserting a diode between the self-starter switch and S3 should however avoid the cranking.

P.V. SINGH

Electronic Congo

Here is a project to build a congo drum. The circuit given here generates a drum sound when the 'touch plates' TP1 to TP3 are touched with a finger. The circuit has provision to sustain the sound for the desired time period.

The heart of the circuit is twin T oscillators built around (BC108) transistors. The three associated capacitors with each oscillator determine the frequency of oscillation. The preset potentiometers VR1, VR2 and VR3 can be adjusted to sustain the oscillations for the desired time.



The mixed output of the three oscillators is fed to the input of a power amplifier. A 15 cm or 20 cm woofer should be connected at the output of the power amplifier for good sound reproduction of the congo.

The circuit, exclusive of the power supply, costs not more than Rs 20.

For better results the following three points should be borne in mind:

1. Tune the preset in the direction of the pitch or sound so that if it crosses the limit, it just stops.
2. Touch the plates by the fingers momentarily. A drum sound will be produced. The sound can be made to sustain for a desired period by fine tuning of the preset
3. If in any oscillator, the oscillation does not stop as mentioned above, replace 5.6k resistance with one of higher value (say 10k or 15k).

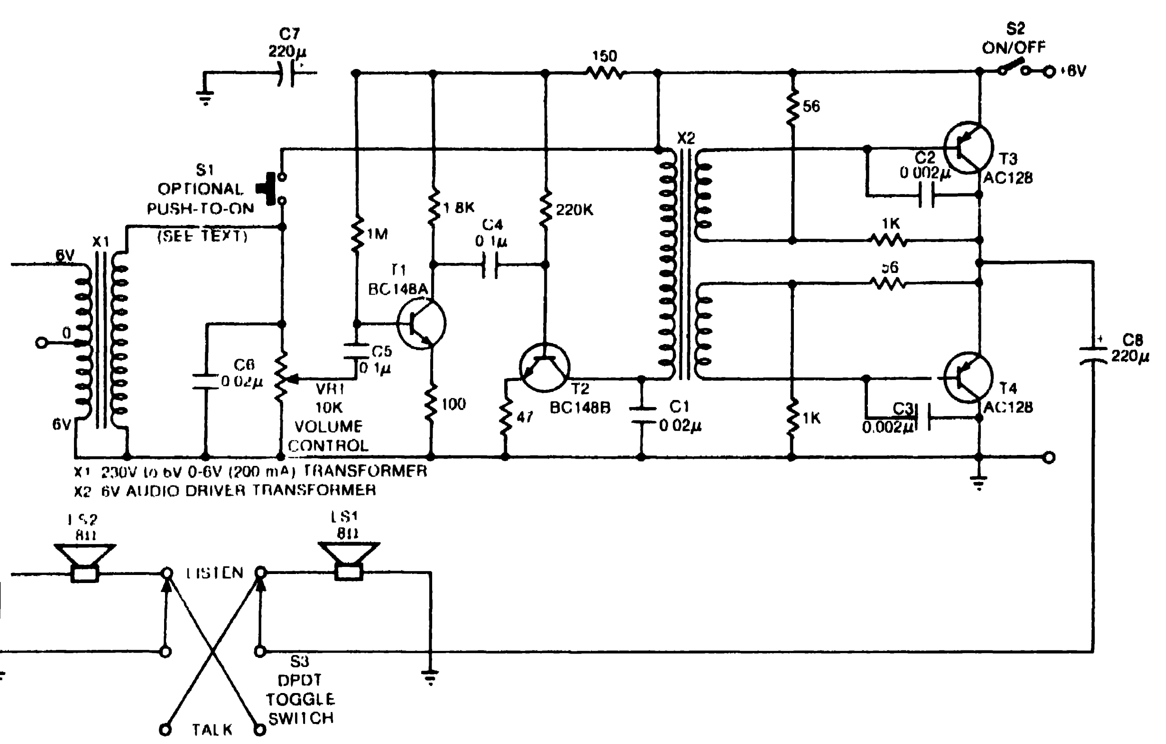
DHIRENDRA BHATT

Low-cost Transistorised Intercom

Here's a simple transistorised intercom which can be assembled in just a day's time. The project uses most common components readily available in the market.

With this intercom a person can talk (speak or listen) to another person say, his assistant by keeping S3 (a DPDT switch) at speak or listen position respectively. The assistant has slave loudspeaker (LS2) while the master unit (LS1 and S3) is with the boss. When S3 is kept at speak position, LS1 (which acts as microphone) gets connected to input of audio amplifier comprising transistors T1 to T4, while LS2 gets connected to output of audio amplifier and vice-versa.

X1 is an ordinary stepdown power transformer with 6V-0-6V (120 mA) secondary. The centre tap (0V) is not to be



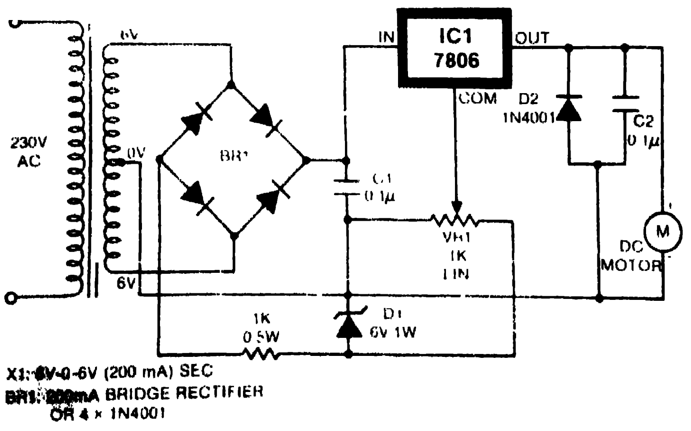
used. The capacitor C1 acts as a tone controller. By varying its value between 0.005μF and 0.05μF, a person can obtain a very pleasant sound.

For incorporating a calling bell, a push-button switch (S1) has been incorporated by using a flexible wire as shown in the diagram.

VIVEK KUMAR TULI

IC Speed Control for Small DC Motors

Often it is necessary to regulate speed of small DC motors in instruments and cassette recorders. The circuit proposed here uses a voltage regulator IC to give precision control of the motor's speed. Once the speed is set it does not change even if the load is increased or decreased. This control is fit only for speed control of small DC motors and not for heavy duty motors. Heart of the circuit is IC 7806 three-terminal regulator which is capable of giving 1A current. Voltage of zener diode should be equal to output voltage of regulator. Circuit can be wired as shown in the diagram and the speed adjusted by VR1 (1k potentiometer). It should be set at the required speed and then sealed.



IC should be mounted on a heatsink and current rating of transformer should be slightly greater than the current required for the motor. This circuit has been used in the cassette deck with excellent result.

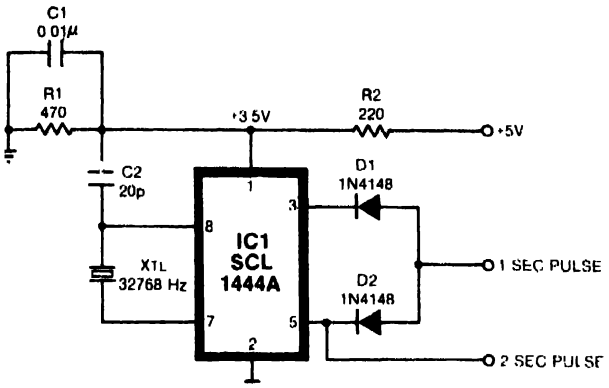
A. SEHGAL

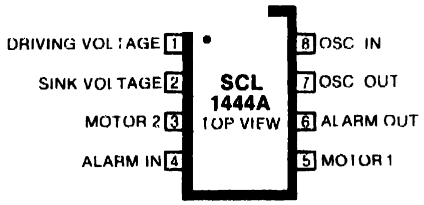
One Second Master Oscillator

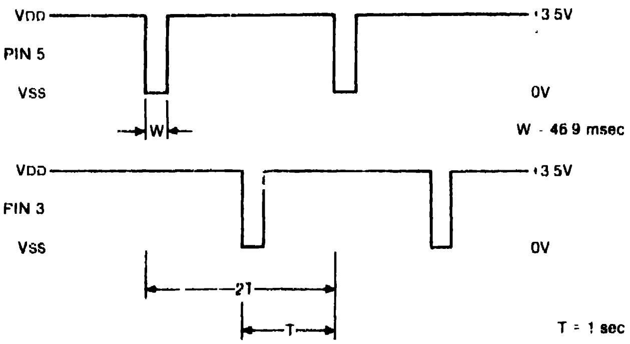
Recently, Semiconductor Complex Ltd., introduced a new CMOS LSI chip SCL1444 A/E for analogue clocks. This can also be used as quartz-controlled master oscillator. The master oscillator can deliver either one-second or two-second pulses and can be easily interfaced with TTL IC circuits. The circuit shown here works satisfactorily.

The SCL1444A/E is an integrated circuit in CMOS silicon-gate technology consisting of an oscillator, frequency dividers, O/P pulse formers, push-pull motor drivers and an alarm O/P. Integrated capacitors are provided for conventional tuning or for laser trimming of the quartz and are selected by mask-option. Due to the low current consumption and low operating voltage, the circuit finds its main application in quartz-controlled clocks driven by a bipolar stepping motor. Its absolute maximum ratings are as follow:

Supply voltage	5V
All inputs	< +5V
Operating temperature range	-10°C to +60°C
Storage temperature range	-30°C to +125°C
Lead temperature	260°C







Power dissipation	300 mW
Output current	4 mA maximum.

An attempt has been made to interface the output of IC with TTL ICs. The optimum value of supply voltage tried at pin 1 is +3.5 volts. Voltage above this value stops the oscillation. This is the limitation of the circuit which should be noted clearly. The pin configurations of IC are also given with circuit diagram.

In the analogue clock circuit, pin 1 is supplied with +1.5V and pin 3 and pin 5 are directly connected to a stepper motor.

IC has a built-in oscillator designed for a frequency of 32768 Hz the using an inverter and having an internal feedback resistor plus integrated capacitors. IC has a special feature of fast test function. This test function is activated if the 'alarm in' is connected to supply voltage. This increases the output frequency by 64 times.

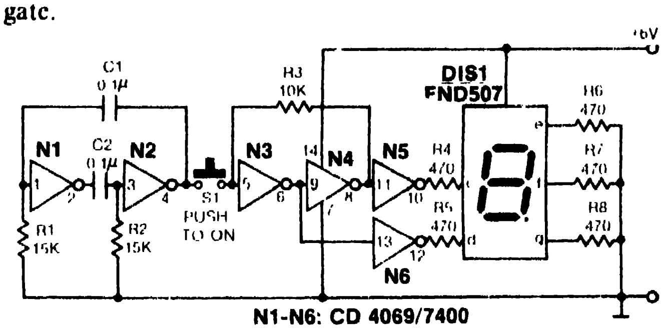
The output waveform of the IC is also shown. The circuit can be used for general purpose timer, quiz-master and other laboratory applications.

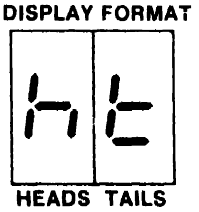
S. BATRA

Heads or Tails Simulator

Here is a heads or tails simulator which, being portable, is convenient for use by cricket teams and other teams for tossing before a game.

As shown in the circuit diagram the two inverting gates N1 and N2 are tasked for high frequency clock. The values of the components are set for the square wave of 1000 Hz. This clock is fed to a flip-flop, consisting of two inverting gates N3 and N4, through a push-to-on switch S1 which behaves like a gate.





The output of the flip-flop is fed to the high-low detector. When output of N4 is high that of N6 is also high. When output of N4 is low, the output of N5 is high.

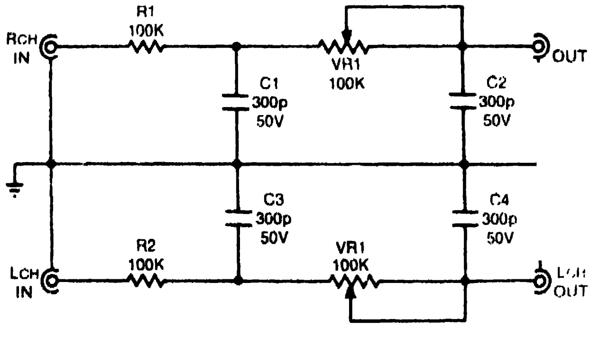
The outputs of N5 and N6 are fed to the 'read out' display. This display reads 'h' for heads and 't' for tails.

If common cathode display is used simply reverse the connections of segments, e, f, g and common point of display from ground to supply and vice versa.

S. VENKATA RAMANA

A Simple AF Filter

If a friend of yours wants to dub his old worn out records on tape, you don't need to start telling him that the recording will have more noise than music. All you have to do is just pass the signal through this filter before recording, and he'll never know what happened. The noise? It will all be gone!



This circuit is very easy to make and inexpensive as it requires only few components. The filter connects between the voltage at the inverting terminal exceeds that at the the signal source such as a recordplayer and the taperecorder. Its cut-off frequency starts at about 5000 Hz, and attenuation increases at the higher noise-producing frequencies. Potentiometer VR1 allows the shifting of the frequency slightly up or down to obtain increased or decreased high frequency attenuation as needed.

For proper operation, the input impedance should be at least 100-kilohm. Some solidstate recorders with input impedances less than 100-kilohm reduce the degree of high frequency noise filtering.

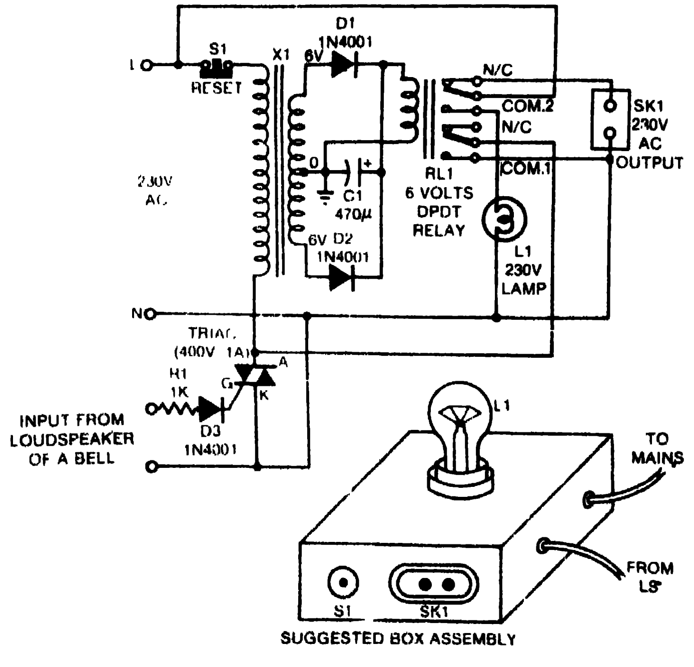
The unit can be housed in a small metallic enclosure. For mono-operation, only one of the input and output sockets is used.

SUNIL DAVID

Visual Indicator for Electronic Doorbell

Powerful hi-fi amplifiers, when in use, usually drown the sound of the doorbell. This visual indicator for electronic doorbell switches off the hi-fi system the moment the doorbell is pressed, thus enabling the sound of the doorbell to come through.

As shown in the circuit diagram, output from the doorbell loudspeaker is fed to the gate of the triac via the resistor R1 and diode D3. The transformer X1 is connected as load for the triac. Whenever the doorbell is operated, voltage appearing across the loudspeaker is rectified and applied to the gate of the triac. The triac fires and this switches the transformer. As soon as the transformer is on, the relay operates and since com. 1 and N/O contacts of the relay are connected across the triac, the triac is effectively removed from the circuit as anode (A) and cathode (K) are shorted.



SUGGESTED BOX ASSEMBLY

The circuit thus gets latched and to reset the circuit, the switch S1 has to be pushed for two to three seconds.

The circuit can be used in two ways:

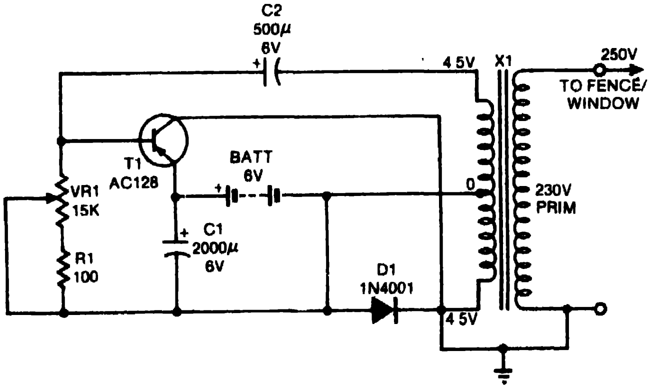
1. Using relay contacts com. 2 and N/O, a bulb can be operated to indicate that the bell has been operated.
2. Using relay contacts com. 2 and N/O, any load such as amplifiers etc, can be switched off when the bell operates.

The whole circuit can be assembled in a plastic butter box along with the switch S1, socket SK1 and lamp holder. A printed circuit board may be used to simplify the connections. Care must be taken to see that the phase and neutral are properly connected. While servicing, care should be taken as mains voltage exists in many of the parts.

BASANI RAMAN

Electric Fence/Window Charger

Fence/window chargers are against the Indian law, but small ones like this which send a very small amount of current can be assembled for hobby or demonstration purposes.



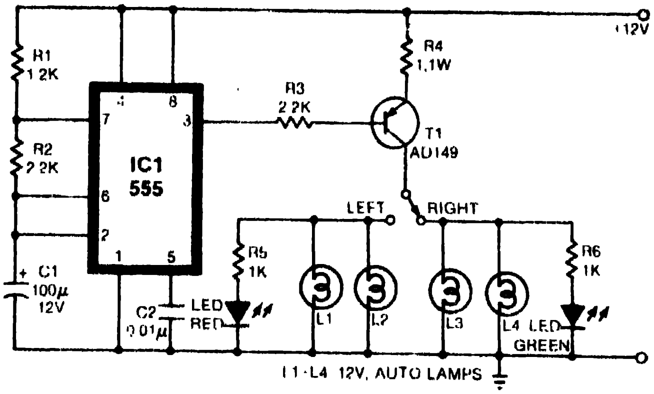
X1: 230V TO 4.5-0-4.5V SECONDARY TRANSFORMER

The heart of the circuit is the AC128 pnp transistor in conjunction with the transformer. The output of transformer is fed back to the base through the transformer in series with the 500μF capacitor. The amount of current to be sent can be adjusted by the 15k potentiometer. The transformer used is an ordinary stepdown transformer but the windings are used for the opposite purpose. One lead of the secondary should be earthed well. Better the earthing, more effective the charger. Care should be taken to connect the battery, capacitors and diode in correct polarity.

ROHIT SHARMA

Automobile Flasher

Electromechanical devices are still being used in automobiles in switching mechanism and blinkers. Electronic automobile flashers have been deviced but these are built around transistors. Here is a simple circuit for the electronic flasher built by replacing the transistors with IC.



The circuit consists of IC 555, used in the device as an astable, that is, free running multivibrator. Output pin 3 is connected to the base of the transistor AD 149 which performs the function of a switch. LEDs on the dashboard panel give the indication of the working of the flasher unit. Rate of blinking is about 95 times per minute.

Lab Note: Blinking rate of the lamps (i.e. the on/off time) can be changed by increasing or decreasing the value of capacitor C1 as per the reader's choice. Increasing the value of C1 decreases the blinking rate and vice-versa. Proper heatsink should be provided for AD149 transistor and LEDs fitted on the dashboard.

AJITH KUMAR

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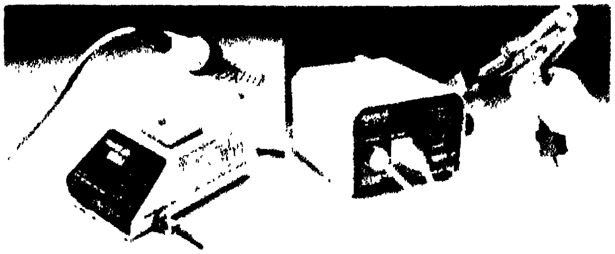

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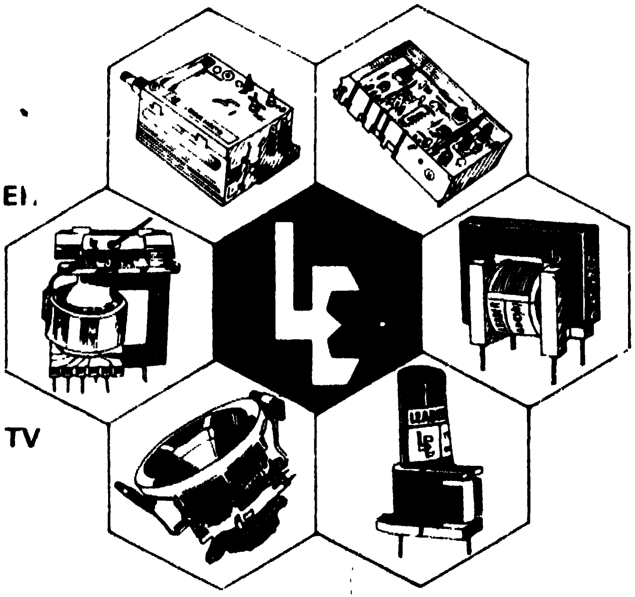

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CAD

CIM

CAM

Dr N. Vanvari

Computers have revolutionised the scope of sicence and technology. These marvel machines have helped mankind to put man on the moon. Not only this, these days, most complicated designs, most arduous manufacturing steps, and time-consuming and intricate measurements are done with help of these machines. This is how the CAD (computer aided design), CIM (computer integrated manufacture) and CAM (computer aided measurements) come in to play an ever increasing role. More often, in literature, CAM stands for 'computer aided manufacture'.

This article covers CAD, CIM and CAM in detail, while giving an outline of other computer-aided systems and effects of computerisation.

CAD systems

CAD, in a narrow sense, is computer aided design, but it would be more appropriate to use the abbreviation CADD, to include both design and drafting.

The basic structure of a CAD system includes an input device called the digitiser, an output device called the plotter and a computer to control the digitiser and the plotter. The computer memorises the data and operates a tape-punching/print-out machine or a display terminal.

For input, a conventional drawing, either actual size or scaled down/up, produced either by the CAD system or by hand, is placed on the digitiser. The digitiser generally uses a rail encoder system, matrix board system, a coordinate reader called the cursor which reads each key point of the drawing, and the computer which converts the information to the X-Y or X-Y-Z coordinate values.

The input data is processed by a computer and stored on a floppy disc. When an operator calls for output, the plotter-control computer recalls the disc memory and data is displayed on a terminal or drafted by the plotter if so needed.

Before a complete artwork is drafted by the plotter, the drawing is generally checked for input errors. The plotter for that purpose is called an inspection high-speed plotter. If input errors or faulty data are found, they are revised. The new data are drafted by the final artwork plotter. These plotters may be either pen or photo plotters. Photo plotters are exposed by light or laser.

There are two types of CAD systems: an off-line system which includes the floppy disc drive and other media; and an on-line system, which directly connects the digitiser and the plotter to a computer. The off-line system is more efficient than the on-line system. But as computer prices are coming down, the distinction between the two systems is disappearing.

CAD systems, which started out in the electronics industry assisting the design of integrated circuits, are now widely used in the aerospace and mechanical engineering industries. This proliferation of CAD from the primarily two-dimensional field of electronic circuit design to mechanical engineering applications has been spurred by the development, in the last few years, of interactive three-dimensional modelling techniques by means of which the user can define and rapidly manipulate solid parts on the cathode ray tube screen. Such techniques and related computer programs not only allow definition of the entire outer surface of an object right from a single part or component to an entire plane, ship, or car, but they also derive important geometric measures from the definition. For example, parts can be rotated to test for clearance.

An example of this class of software is the Euclid system, marketed by Matra Datavision of Burlington, Massachusetts, USA. With Euclid, a user can build any three-dimensional shape by combining simpler shapes, such as cones, spheres, and boxes. Shapes can be added and subtracted, merged, or cut away while they are presented on the screen. The package can calculate the volume, surface area, center of gravity, and moment of interia of any described object, and it can use the descriptions to produce drawings or derive numerical-control machine tool programs for cutting the parts out.

Though some 3-D software packages incorporate the production of 2-D representations and drawings, separate 2-D drafting systems are also widely used. Probably the best known is the Cadam (computer augmented drafting and manufacturing) system, which replaces the conventional drafting board with a CRT screen, from the Lockheed Corpn Burbank, California.

CAD of PC boards is also becoming indispensable in the competitive development of high-quality products. For

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Dr N. Vanvari is deputy general manager, Haryana State Electronics Development Corporation Limit, Chandigarh.

long, 2-D CAD systems for PCBs did not become popular because of (i) high cost, (ii) special installation environments required, (iii) complex operation, (iv) slow response, (v) wiring patterns less well-ordered than those designed by man, and (vi) difficulty in making corrections and additions. However, with introduction of advanced graphic terminals at one-third the price of what it was four years back, use of 16-bit microprocessor and a high-speed vector generator, have solved these problems.

Outgrowth of CAD

Computer-aided engineering (CAE) is an outgrowth of CAD, and design automation was first used in electronics for designing PC boards. The first CAD programs, implemented 20 years ago, were created by individual companies and run on large, time-shared central computers. They assisted circuit board layout by allowing draftsmen to enter points on a digitising table and to specify components with keyboard entries. Simple analysis programs were often added to check for connectivity

By 1970, minicomputers were used to run stand-alone CAD systems which sometimes served as front ends for design-automation programs. With such hybrids, it was possible to develop a complete set of engineering drawings from a hand-drawn schematic.

CAE brings the computer further upstream into the design process from the physical aspects of the design to the design itself. Using CAE, an engineer can conceive, design, simulate, modify, and draft a circuit at a single work station.

The typical CAE work station consists of a keyboard, graphics tablet, and display. The graphics tablet may be used to draw components directly, or select items from a menu by pointing to them. Design files built up from a library or parts can be displayed and edited. They can also be simulated directly on the display or reformatted and sent to external simulators for more complex analysis.

Communication between different CAD systems

Take the case of CAD equipment. Suppose the objective is to design a right circular cylinder. Manufacturer A might opt for a CAD system in which the cylinder is treated as a primitive (perhaps together with other primitives, such as blocks, cones and spheres). Manufacturer B's equipment might handle the cylinder as a circle moving along its axis. Manufacturer C might design the cylinder as a line revolving around another line. Manufacturer D might consider the cylinder as a regular polyhedral whose number of sides reaches infinity. Each approach has its advantages and disadvantages. But without outside help, systems A, B, C, and D cannot communicate, atleast not about right circular cylinders.

In the absence of standards, how can the CAD systems be made to communicate? One approach is the custom interface. Manufacturer A would have to offer custom interfaces for systems B, C, and D. Likewise, manufacturers B, C, and D would each have to offer three custom interfaces. But, though this approach may work, it would not help a bit should another manufacturer E come along with yet another scheme for generating a right circular cylinder. Therefore, it is easy to see how the custom interface approach can lead to a rapid proliferation of devices.

Another approach is that of the initial graphics exchanges specification (IGES), a project of the US Air Force ICAM (integrated computer-aided manufacturing) program. The project is jointly funded by the Air Force, Army, Navy and the NASA (national aeronautics and space administration) and coordinated through the ICAM office. The National Bureau of Standards directs and coordinates the effort.

Getting the most out of CAD

Most systems managers rely on 'return on investment (ROI)' measures to determine if a given CAD system should be bought. They measure how increased productivity of a given function, such as drafting, saves money for the company and compare this with the cost of the system itself. A 20 per cent rate of ROI might justify the purchase (with interest rates at 12 per cent), but a 10 per cent rate would not, they reason.

The problem with this approach is that it focuses on the CAD system alone. To maximise the system's productivity, managers using ROI analysis try to keep the system as busy as possible, using applications that increase productivity the most. However, quite often these applications are not those most required by the manufacturing operation as a whole. Equally important, such analyses ignore the improved quality and shorter delivery times that can be achieved by linking the CAD system to other automated systems.

Advantages of CAD systems

CAD offers manufacturers three primary advantages. First, it increases the productivity of design engineers by doing routine tasks for them, such as sorting and searching through plans, labelling, and of course, drafting. Secondly, by substituting three-dimensional computer models for physical models, CAD reduces costly prototyping. Thirdly, CAD smoothens the transfer of information from the designer to the manufacturing section.

CIM systems

The use of computers to control manufacturing has long been routine in continuous-process industries, such as chemicals and oil refining, but only in the recent past has it been introduced in batch-manufacturing industries, such as metal working. The metal-working industries employ by far the largest share of industrial workers in all the advanced countries and a large percentage of their products are manufactured in medium-sized batches, ranging from hundreds to thousands of products in each batch. It is not feasible to produce such batches by rigid mechanised techniques, like those used in the large-batch automotive industry. To speed up medium range production, the flexibility of computerised automation is needed.

The arrangement is called flexible automation because many of the machines can make different products merely by changing the software commands. Fixed automation, by contrast, uses machines programmed to make only one product. A change in product here calls for retooling.

Fixed automation leads to CIM, which is intended to integrate not only CAD with robotics for automated assembly or production, but also automated materials handling as well as resource planning and control systems, all working from a single data base.

After all, the entire manufacturing industry is heavily dependent on data communication, starting with the preliminary design of a product and continuing through production design, manufacturing and sales. Instead of recreating and reinterpreting the data at each stage of the process, a manufacturer can avoid duplication by organising and storing in a computer,information such as the geometry and dimensions of parts, parts numbers, parts lists, manufacturing resources, assembly procedures, scheduling inventory and inspection results.

A good example of a large, complex and successful data base is the Boeing Commercial Airplane Company's CAD/CIM integrated information network (CIIN). Boeing uses CIIN for the design, development, and manufacture of aircraft; the new Boeing 757 and 767 jets are just two of the products that have benefited from CIIN.

However, manufacturing engineers know they've barely scratched the surface in applying computers to the manufacturing enterprise. Even today, the most highly automated manufacturing operations still require human intervention. In Toshiba Tungaloy's Kanwasaki plant, lathes and grinders operate unattended through the night shift, but tools are examined for wear prior to leaving the machine unattended. But then, during operation, a broken or worn tool causes automatic shutdown of the machine. The ideal system in such cases would be a self-correcting machine tool, a concept under study by the National Bureau of Standards, USA. Artificial intelligence techniques are also being introduced in automated manufacturing for taking into account unexpected events, such as tool breakage or a robot gripper dropping a part.

After a product is designed, an intermediate step, viz., planning of the production process, is required before it can be manufactured. Traditionally, production decisions have been made on the factory floor based on trial-and-error experience. But in today's computer age, a strong movement is underway to let the computer decide.

Until recently, companies relied on skilled machinists to make final and detailed decisions that determine the production process. But with the growth of numerically controlled (NC) machine tools, these critical decisions must be made in advance by NC programmers and planners who often have little production-machining experience and hence do not understand fully the effects of their decisions. Thus, today's tooling and machining techniques often have serious shortcomings.

A computer-aided production process/planning (CAPP) system is the vehicle to perform this task. But the key to the effectiveness of CAPP is adaptability. The system must be able to adapt to changes in the production process as, for example, new machine tool capability and tooling or changes in technology.

The two basic aspects of planning a machining operation are macroplanning and microplanning. In macroplanning, a specific sequence of operations on preferred and alternative machine tools is selected. In microplanning, the details of each process operation are selected. For machining operations, this involves the choice of cutting tools, cutting sequence and depth of the cut, cutting speed, rate at which the part is fed against the tool, lubricating fluid, and replacement of worn tools.

FMS systems

As discussed earlier, full systems of computer-integrated automation do not exist yet. But, microcosms of atleast a portion of such systems are now operating in the form of flexible manufacturing systems (FMS). Such systems generally consist of groups of machine tools served by automated tool-and-workpiece transport and handling equipment, all operating under integrated hierarchical computer control to produce broad families of machined parts. The results already obtained from these systems indicate that full computer-integrated automation is feasible.

Simulating a FMS on a computer before the system is built saves the cost of trial-and-error experimentation. Since the cost of changing a FMS is often measured in hundreds of thousands of dollars or even millions, and since such changes are possible because firm design rules have not yet been established for any FMS, computer simulation can pay for itself many times over. Moreover, simulation can also help improve a functioning FMS and alternatives can be tried without shutting the system.

The FMS now operating at Messerschmitt-Bolknow-Blohm (MBB) in Augsburg, West Germany, is one of the most sophisticated in the world today. At Augsburg, MBB builds the center section—the wing box and its related structure—for the swing-wing Tornado fighter plane. Ten Tornados are being produced every month.

Robotics

In all the industrialised countries, the simpler applications of CIM, such as stand-alone robots, have been expanding much more rapidly than the bigger and much more complex FMS units.

Computer-controlled robots can now assemble up to 15 components per minute on printed circuit boards with 25 micrometer precision. The robot with four servo motors is capable of handling standard as well as non-standard components.

Robotics will clearly play a greater role in future automation -this despite it's being called, among other things, "a passive, stupid machine that deteriorates rapidly under load."

Meanwhile, robots are proliferating in heavier industries such as automobile manufacturing. Volkwagen plants in West Germany, for example, had 950 robots as of mid-1983, with more than twice that number expected to operate there by 1990.

Sweden is probably the most active of the Western European countries in CIM, because the virtual elimination of night-shift work in that country has put a high premium on the development of unmanned third shifts. By comparison, in Italy, which has a much larger economy, only about a third as many robots as in Sweden are used. They are concentrated almost exclusively in three companies: Fiat, Olivetti, and Alfa-Romeo. Robot use in Britain is even more limited.

Automated factories

The USA, Japan or West Germany may in the near future build totally automated factories with the assistance of CIM technology and integration of CAD and CAPP with robotics. Products manufactured in such factories will be of consistently good quality, can be produced faster, and will be much cheaper. These will benefit the manufacturers as also the industry automation suppliers. There is a vast market for equipment and computer technology catering for completely automatic plants. In the USA alone in the next decade it may hit the $ 100 billion mark.

Manufacturers having partly automated factories are keen on linking the islands of automation. They are persuading industry automation suppliers to provide interfaces and to come up with system integration standards. With such standards being formulated, it is projected that by 1998 the shop-floor CIM is likely to be fairly common in General Motors, USA.

Rapid progress in the development of CIM in all industrialised countries will almost certainly lead to the construction of a prototype of a fully automated factory sometime in the next few years. CIM is to make possible not the factory of the future or the office of the future but rather the business of the future.

CAM systems

Establishment quality control methods, long considered a bottle-neck in production, are yielding to fundamentally new, automatic methods. These new methods are giving valuable feedback to the machining and assembly processes, just as automatic quality control has done in the chemical industry.

Quality control used to mean statistical sampling—chiefly manual inspection and testing. This ensures average product quality but does not by iself seperate good units from defective units. At the same time manual inspection is slow and monotonous.

The new technologies --computer-aided inspection and computer-aided testing use computers in conjunction with advanced sensor techniques. Probably the most exciting of the new sensor technologies is machine vision, in which computer systems process and interpret the image data. Quality control methods, of course, include both inspection and testing and both of these involve measurements.

Inspection and testing

Inspection refers to the measuring of manufactured part in relation to its design sepecifications such as checking the dimensions of the part against an engineering drawing with a micrometer or a go/no-go guage. Inspections are made on incoming raw materials, in-process parts, and completed products. Through testing, the function and performance of the product can be found out. For example, final testing before shipment to a customer, environmental testing, and fatigue testing will give the performance characteristics of the product in different situations.

Inspection can be contact or non-contact. In contact inspection, a manufacturer may use automatic coordinate measurement. A computer-controlled machine holds the part in a known position while it moves a sensing probe, determining the position of the part's surface when the probe makes contact. The coordinate-measuring machine operates like a numerically-controlled machine. It can be programmed to carry out a sequence of inspection operations in a small fraction of the time required for manual inspection.

However, it is in non-contact inspection that automatic methods improve productivity the most. Measuring or gauging a part without making physical contact with it allows higher rates of inspection than contact methods, avoids the need to reposition the part, and eliminates wear on mechanical probes. Here machihe vision is the most important technology. With an untiring eye, a computer-guided vision system can inspect a complex circuit pattern for flaws. Other non-contact inspection methods are based on electric fields (reluctance, capacitance and eddy current), ultrasonics, and radiation.

Non-contact inspection can be done at rates comparable to production rates. So, it is feasible to integrated the inspections into the manufacturing process. Moreover, inspection can be done on a 100 per cent basis rather than the traditional statistical sampling approach. Product defects can be corrected as they occur.

With 100 per cent on-line inspection, computerisation automatic feedback control can compensate for process errors and allow parts to be made much closer to the minimal design specifications, rather than merely within tolerance. The computer can identify not only out-of-tolerance conditions, but can also analyse trends in quality during production.

Automatic test equipment

The computers can either be built into the measuring instruments themselves or the instruments can be interfaced with the computers or with calculators through bus-connected systems for computer-aided measurements (CAM).

A dominant trend in bench test equipment in recent years has been greater processing and analysing of data by the instruments themselves. Oscilloscopes, logic analysers, waveform analysers, and the like incorporate microprocessors with built-in software for displaying graphics of the measurements. Many of the instruments also have highly accurate cathode-ray tubes with better resolution and image placement and complex keyboards for entering data and for programming.

At the same time, automated test equipment (ATE) designed for very large scale integrated (VLSI) circuits continues to be the focus of increasing competition. As ICs become more complex and are endowed with more functions, the preparation of test programs becomes a problem of greater importance. Test programs may be divided into testing patterns and main programs. Most test patterns in use today for gate arrays and random logic ICs use automatic generation through CAD systems. Here, interface software for connecting the CAD system with the testing systems becomes necessary. Testing patterns for memory ICs are based on algorithmic patterns, and while there are not an overwhelming number of steps, simulations are nevertheless necessary for humans to construct such patterns.

The role of the VLSI chip designer and the test engineer overlap as greater circuit complexity makes early planning an important part of test strategy. ATE, introduced during last few years, makes testing more efficient by generating test programs from data used during design of VLSI chips.

ATE manufacturers are emphasising the use of computers to correlate data on LSIs/VLSIs obtained during many stages of manufacturing. One such system is Tracs, a software developed by GenRad Inc. of Concord, Massachusetts. Tracs (test and repair analysis and control system) collects the data generated during component (LSI/VLSI), printed-circuit-board, and system testing, along with information about where and when each unit was manufactured or assembled. If a part fails at any point during manufacturing, the failure can be correlated with other failures to determine weak points in the manufacturing process. The system also collects data from field engineers and technicians, who enter their information into a computer by using a touch-screen with menu formats. Thus faulty products that elude screening during manufacturing can still be used to provide additional data about the manufacturing process.

Improvements on in-circuit testers centered on greater automation and, again, higher speed and pin counts. For example, Marconi Instruments Incorporated's system 80, a circuit-card test station, has new features aimed at reducing repair time for faulty boards. With the Model 1924 repair station, an option for the system 80, detected faults are transmitted to the repair station and stored on a disk. When the circuit board is taken to the station, the disk data is used in a computer graphics display to produce a colour drawing of the trace card. The faulty component is highlighted in a contrasting colour. This eliminates the need for an operator to search out the component from a fault list.

The testing of VLSI circuits is becoming complicated as the chips themselves grow beyond 250 pins and increase in speed to over 40 MHz. In addition, the greater acceptance of level-sensitive scan design (LSSD) and other technologies by test engineers has placed new demands on VLSI circuit testers. With such techniques, testers must do more calculations than before. Consequently, the testers themselves are undergoing a transformation in architecture to accommodate these new techniques. The manufacturers of then testers disagree, however, about what architechture is appropriate. Testers introduced last year by several companies offer diverse tester architectures.

Large systems

In large testing systems host computers are connected with testing systems or to each other. Host computers are also connected with more powerful computing systems. Often, one host is connected with eight to sixteen testing systems. Connection of different kinds of testing systems, such as for testing LSIs/VLSIs, memories and linear ICs, is also possible.

The connection of host computers in the same plant is achieved by constructing a local area network (LAN) employing optical communications. To connect plants in rural areas of Japan, general public communication circuits and leased circuits are used for data transmission. Linking of overseas plants with hosts for data transfer, on the other hand, is accomplished by satellite communication.

The high speed of LANs, which transmit serial data at about 10 million bits per second, makes them and the computer systems connected to them difficult to test with equipment not designed specifically for that purpose. The problem involves not only capturing serial data, but also sorting through network traffic and extracting from it the data relevant to the test. The engineer must deal with the data not as a stream of ones and zeros, but as packets of data, each with a source, a destination and content. Identifying those packets in a stream of bits requires latching the bits into a high speed semiconductor memory and using combinatorial logic to decode the network protocol. Protocol varies for each network, and general-purpose equipment can be reprogrammed to interpret different protocols.

Although equipment for testing networks is available, most of it responds too slowly to analyse the data. Many general-purpose testers have serial ports for capturing data and microprocessors for interpreting network protocol, but they can only sample portions of the network traffic, allowing the rest to pass by. Though testing a network often involves examining a small slice of the traffic, that slice must be picked out selectively, not arbitrarily.

Advantages of CAM systems

CAM systems are preferred because of inherent enhanced accuracy, quick testing with larger through put, possibility of on-line control in the fabrication line and lastly, the manipulation of relevant data for many useful visual checks on the performance. Measured and relevant data can be stored in the computer memory for future use also.

Computer assisted and controlled services

Communication, control, maintenance and servicing are some of other fields where computers have made inroads. Some examples are given below:

Computer-aided aircraft servicing. The world's first computer controlled de-icing system for aircraft, capable of de-icing automatically the entire body of an aircraft in one minute (compared to half-an-hour required to manually de-ice just the wings), went into service at Kallax airport outside Lulea, Sweden, in November, 1984.

The system consists of an over-head gate with 172 jets for spraying the upper surface of an aircraft with de-icing fluid as it taxis out to the runway for take off. The amount of chemical required is precisely calculated by the computer, in part based on up-to-the minute wheather information. Another important part of the system is the surface over which the aircraft passes. This surface is pitched so that the de-icing liquid running off the plane can be collected and recycled, a feature that is both economically and environmentally advantageous.

Most important, the new system overcomes the biggest drawback inherent in the existing method of manual de-icing the fact that the ice formation takes place on the wings before the process of de-icing the entire aircraft is been completed.

Conceived five years ago by Kjell-Eric Magnusson, an SAS efficiency engineer, the new de-icing system was produced at a cost in excess of $ 1,600,000 as the result of a large-scale cooperative effort involving several leading Swedish companies including ASEA and Alfa-Laval, and master-minded by innovation of Thomas Nilsson.

Thomas Nilsson estimates there are some 600 airports around the world where the system should be of interest, particularly those where frozen rain is a problem.

Computer-aided instruction. The lure of computer-aided instruction (CAI) is once again felt by those who have maintained their interest in this problem-ridden educational tool and believe that advances in the technology will give it another chance. In the late 1960s, it was supposedly going to revolutionise the learning process, the best teachers were going to write 'courseware' (interactive educational computer programs) that would be nationally distributed. Students would learn rapidly and efficiently.

Program logic for automated teaching operations (PLATO) is by far the largest general-purpose CAI installation in America. PLATO is both an interactive network for delivering CAI, and via its programme language, a means of lesson writing. Some 16,000 hours of CAI-related material have been created for PLATO, of which about 4000 hours are used regularly for CAI and about 500-800 thousand hours for writing.

Computer-aided sleuthing. Computers, used for years by law-enforcement agencies to maintain crime statistics, are assuming new roles as important aids in solving crimes. Using computerised fingerprint files police officers in some countries can now get positive identification and the criminal record of a suspect within a few hours of arrest. Electronic data banks are providing fast identification of thousands of substances by their spectroscopic 'fingerprints' and prosecutors are beginning to use computers to correlate evidence in complex cases to obtain instant briefings in preparing to cross examine witnesses. Also, computers are now doing previously manual or partly automated tasks such as fingerprint-file searching, faster and more accurately than could be done by humans.

New computer-based tools, such as voiceprint identification, are also coming into limited use. However, although computers can now give police lists of possible suspects and confirm or deny hypotheses through analysis of physical evidence, the task of finding the guilty and proving their guilt remains highly subjective, and this is likely to prevail in the foreseeable future.

Computer-aided exploration. Large-scale incursion of computer technology has made substantial progress possible in oil exploration and drilling by economising the cost, enhancing the efficiency of operations, optimising processes and systems, planning and production patterns and schedules. The use of variety of latest computers like IBM 370/45, VAX 11/780, CYBER 800 has already changed the performance efficiency of India's main exploration agencies like ONGC and Oil India.

Effects of computer aids

Automation seems inevitable. Even if it had no social value, competitors would exploit it to gain an economic edge. On the other hand, its proponents say it will raise the general standard of living and they note its ability to release workers from monotonous jobs for more creative or intellectual employment. Even so, workers have been understandably uneasy when faced with displacement by a piece of machinery that operates itself.

The replacement of human labour with robots and other machine-labour in batch manufacturing is taking hold, but the resulting social effects have yet to receive detailed study.

On the one hand, such machine-labour offers potential benefits to workers, including more interesting jobs and increased responsibility. For engineers and planners, computers make information more accessible. Many argue that society as a whole will benefit from higher productivity and economic prosperity brought on by more automation while on the other, some workers have lost their jobs. Those who cannot or will not learn new skills are having problems adapting to the new work places. Some observers say a rift is developing between technically capable and incapable workers. And some engineering managers fear that designers communicating through computer terminals instead of personal conversation will be less innovative.

The effects of automation on world employment over a long time are being hotly debated by government groups, professors, industry executives and unions. Some say robotics and flexible automation will create more jobs than they eliminate; others see automation leading to increased productivity and economic well being. Pessimists contend that since society naturally distributes wealth unevenly, the gulf between rich and poor will widen as more and more jobs in the lower strata are eliminated by computer-driven machines.

"A major net replacement of people by robots in the work force surely will not occur" in the next decade or so, the National Science Foundation of the USA reported. "In fact, more jobs may be created than eliminated, as has been the case with other forms of automation."

Robots have the potential to eliminate two million jobs in the metal working industry of the USA by 1990, according to Robert Ayres and Steven Miller, professors in robotics applications and social implications at Carnegie-Mellon University in Pittsburgh, Pa. The authors project that half-a-million jobs will open up because of industrial expansion.

Although computer-driven automation gives the worker more responsibility and autonomy, it also gives him less control over the process he is tending. The loss of a sense of control can make jobs as mahine tenders undesirable, according to Robert T. Lund, a senior research associate at the Centre for Policy Alternatives, Cambridge, Massechusetts, USA. And since computers give managers easy access to data, many workers are reportedly anxious about their performance being monitored, he said.

Thus, while the unattended factory seems an unrealistic dream, the need for social adjustments to the industrial world's advance towards fully automated enterprises is very real.

When a fully automated, a plant can to produce components weighing upto 500 Kg and measuring 1 m in any dimension. About 10 technicians will be needed to supervise production. But the plant will have output similar to that of a conventional factory employing 700 workers.

Conclusions

The output of a manufacturing unit is inevitably accompanied by a flow of information. It is this flow that is being computerised and used to tie designing, machining and forming operations, testing and inspection and marketing together as an efficient, flexible and productive whole.

Computer technology has helped man to user in an era of socioeconomic progress by speeding up the qualitative and quantitative expansion of all production and management sectors. There is no production sector, including agriculture, which is not reliant on it for its progress and where the impact of its use is insignificant.

With the integration of computers with audio and video systems, the machine and man inter-changeability has become a reality. Now, computers can listen, talk, see and think, though still in a limited sense. Therefore, some of the tasks which were being performed by a man are now being handled more effectively by CAD-CIM-CAM systems.

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3. Divakaran, R. **Computers in oil exploration**, PTI science service, Vol. 4, No. 3 (Feb. 1-15, 1985).
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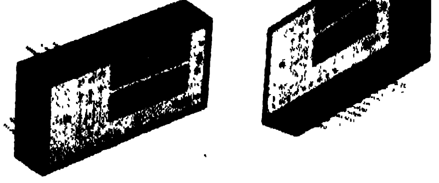
□

Transducer including Linearization (Output current or voltage)

PROMET UNI



Description and Advantages

PROMET UNI is a temperature converter with high accuracy for Pt-resistance sensors, including linearization of the sensor characteristic (acc. DIN 43760).

Different possibilities concerning output signal and power supply.

Lay-out as a miniature thickfilm hybrid module, molded in epoxy case.

The module needs no external components, only power supply and Pt sensor input signal.

The zero point and the measuring range are continuously adjustable by means of two precision trimmer potentiometers, incorporated in the module

Dimensions
40×20×8,5 mm
Weight 12 g

METALLUX
VISHAL
Vishal AGENT IN INDIA
AGENCIES
14-10-7451/1, DHOOLPET, JUMERAT BAZAR
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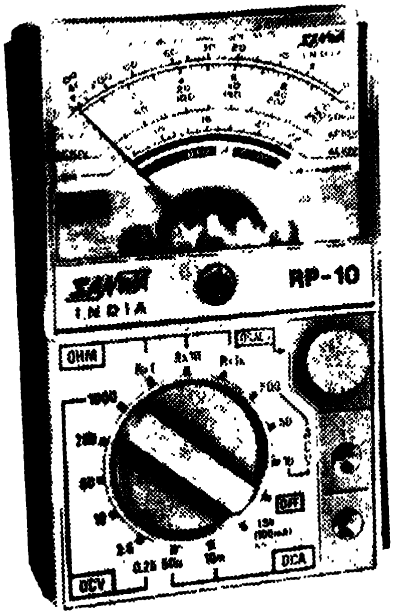
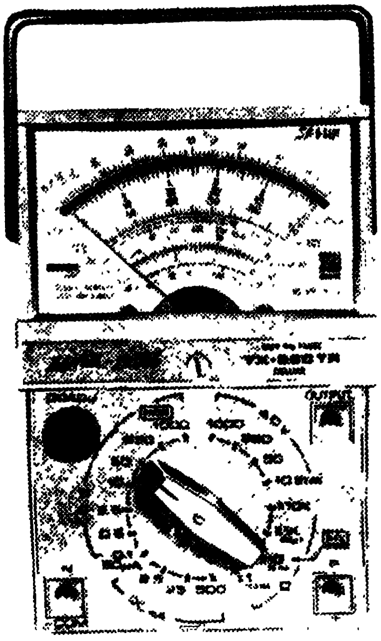
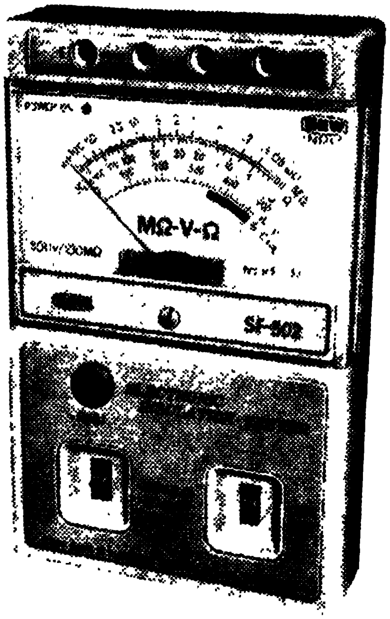


Model RP-10 Multimeter
(pocket size)
20KΩ /V DC, 10KΩ /V AC



Model YX-360 TR Deluxe
Multimeter
20KΩ /V DC ,8KΩ /V AC

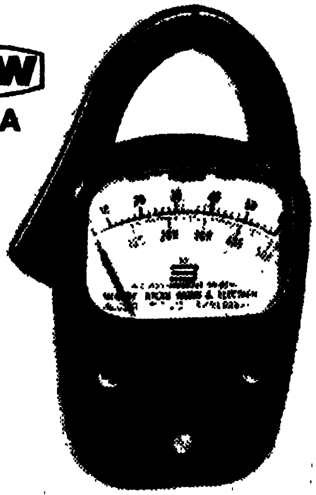
SANWA-INDIA
produces sophisticated
electronic instruments for
precision testing.



Model SF-502 Insulation Tester
500V/100MΩ
Low ohm 8 AC 500V

SEW
INDIA

H.V. Probe
25 KV DC



Model ST-3 Tong Tester
(pocket size)
0-60A AC, 0-500V AC

SANWA-INDIA

PRECISION INSTRUMENTS

For further details :
ATLAS RADIO & ELECTRONIC INDUSTRY PVT. LTD.
57, GIDC Industrial Estate, Naroda - 382 330, Ahmedabad

Navnit/171/88

Product Profiles

INSTAPRINT DRY TRANSFER

This Instaprint Dry Transfer comes in three sizes viz A4 A6 and strips and is manufactured in collaboration with the pioneers of letraset of the UK A4 is 297 × 210 mm A6 is 100 × 150 mm and strips 30 × 210 mm in dimension In the standard sheets upper case lower case and numerals are manufactured for A4 and A6 sizes and in strips capitals A-Z and numerals 0-9 right from 2 mm onwards to 2 54 cm are offered

Contact Wood Stock Inc 31/32 Kamadhenu Annexe M G Road Trinity Circle Bangalore 560008

INK SAC

This new Ink Sac SI-AE-001 is an import substitute suitable for imported instruments using ink sacs It has very good siphon system-operated ink container plastic tube 15 cm long which can be varied as per customer s specification Diameter of the tube can also be varied as per customer s choice Available with inks of red blue violet, orange, green and brown colours precision recording inks Ink sac can also be supplied as per specification All ink sacs supplied are centrally sealed

INK SAC

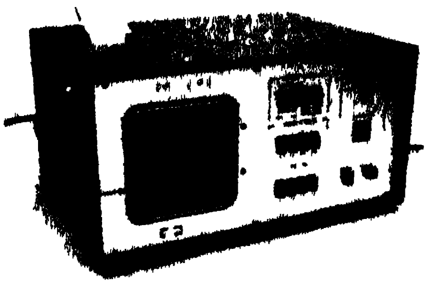
Ink Pads suitable for GE model No HG-5000 are also manufactured as per original GE ink pads These pads are made from best quality soft wooden felt which can absorb good quantity of pad inks Suitable pad inks can also be supplied along with pads

Contact Arora Enterprises 301 Sheth Chambers Marimata Street, Rajmahal Road, Vadodara 390001

DATALOGGER

This Datalogger is suitable for various parameters viz temperature, voltage, current, pressure, frequency, pH, conductivity, etc The basic instrument is suitable for 24 input which can be extended further. The display of time, channel and signal is provided on the display board

The equipment has auto and manual scanning arrangements and selectable print cycle interval The time has reset fast set slow and hold facilities The equipment is engineered to optimise circuit performance in the most demanding research and industrial applications



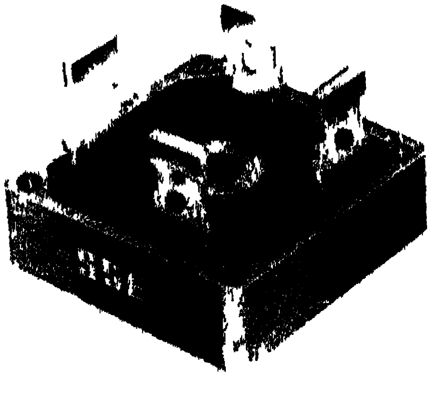
DATALOGGER

Input is compatible with various sensors and signal can be scaled to various engineering units The signals of various channels are printed with respect to time in the form of digital printout

Contact Century Instruments Pvt Ltd S C O 289 1st Floor Sector 35-D Chandigarh 160036

MODULAR RECTIFIER BRIDGE

This Modular Rectifier Bridge weighing about 21 gm is made from the silicon wafer state so that the user is assured that only choice quality materials are used This four-terminal device is built in a full metal body having each polarity embossed thereon The fast-on termination is also suitable for wire wrapping or soldering Superior quality female push-on terminals are available on request



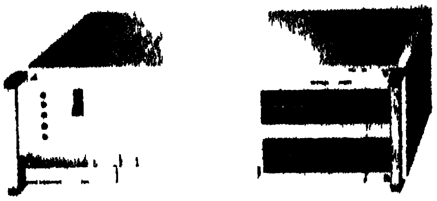
MODULAR RECTIFIER BRIDGE

The module is available in 5, 10, 25 and 35 amps (average resistive load current) ratings for RMS input voltage up to 420 VRMS with 2500V isolation Since current derating graphs are given along with power dissipation graphs, user has no problem in deciding on choice of 'free-air' or 'chassis or 'heatsink' mounting A single 3/16 bolt-nut washer completes the mounting in any location

Contact Solid State Electronics Co Pvt Ltd Plot No 9/123 Marol Co operative Indl Estate, P O Box No 7432 J B Nagar Post Bombay 400059

MODULAR COMPUTER

This Modular Computer is a fully configured microcomputer complete with two 13cm floppy drives A video monitor along with keyboard is all that is required to complete the system This is available in a standard 47 5cm rack with all Eurobus boards A printer of required capacity and specification can be connected to the rack



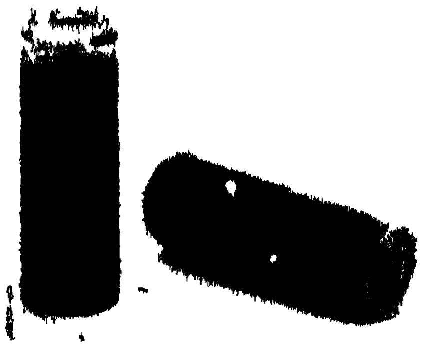
MODULAR COMPUTER

The unique feature of this system is additional three slots for user-defined expansion such as program development and debugging It can also be configured as a target system by using necessary modules such as processor module I/O module and memory module

Contact Arun Electronics Pvt Ltd B/125 126 Ansa Industrial Estate Saki Vihar Road Bombay 400072

ROUND INK CARTRIDGE

This latest ink cartridge is an import substitute to USA s Hagon recorder cartridge The dimensions exactly match the original ink cartridge It can be supplied with slow-drying



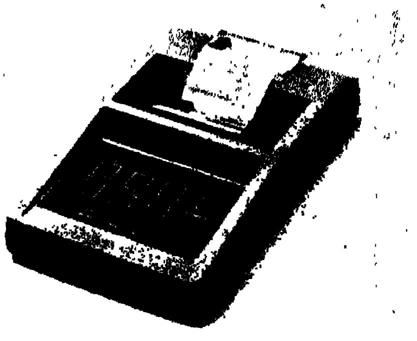
ROUND INK CARTRIDGE

inks of red, green, blue, black, violet, orange and brown colours. The cartridge is made from virgin low-density polythylene. The ink used does not contain any acid or alkali and is harmless to pen tips.

Another cartridge suitable for the kents recorder is also available. This ink-filled cartridge can be supplied with red, green, blue, black, violet, orange and yellow colour inks The cartridge is made from best quality, low-density polythylene The dimensions of the cartridge are 28.3 mm × 22 8 mm × 5 8 mm.
Contact. Suvichem Inks, 1064 Shahbad, Bareilly 243003.

COMPACT PRINTER

A&D Company, Japan is introducing an innovative low-cost thermal dot-matrix printer to match its line of weighing indicators and balances. With dimensions of only 94 × 160 × 34 mm this ultra-compact printer has a surprising number of features for such a small and low-priced unit



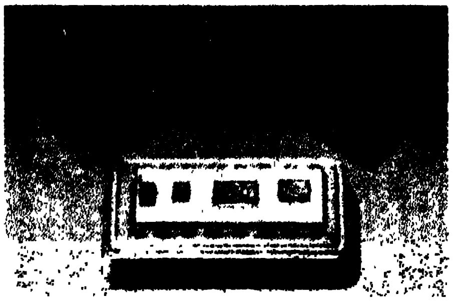
COMPACT PRINTER

The AD-8116 can print weight, net weight, gross weight and tare weight to a maximum of seven digits. When used with counting balances it also prints quantity, piece weight and accumulated quantity In addition, the AD-8116 is equipped with a statistical function which when activated prints number of data, accumulated total data, maximum among data, minimum among data, average of data and standard deviation. An automatic print function prints data when the unit receives an external print command Otherwise, data is printed whenever the print button is pressed.

It prints 2mm high characters on thermal roll paper at about one line per second with 16 characters to the line Font is 5 × 7 dots. It uses an RS-232C interface mode
Contact Universal Biochemicals, Enzyme House, 6 Sathya Sayee Nagar, Madurai 625003

HYBRID DATA ACQUISITION AMPLIFIER

Analog Devices Inc., has introduced a hybrid data acquisition front end for applications requiring amplification and acquisition of wide dynamic range signals. Offering 12-bit performance, the AD365 combines a programmable-gain instrumentation amplifier (PGIA) and a track-and-hold (T/H) amplifier [illegible] single package. The hybrid makes use [illegible] Devices' proprietary IC technology [illegible] chip count and enhance performance. Its low-noise instrumentation amplifier delivers 0.2 V peak-to-peak input noise, lower than any other PGIA available. The ability to replace four to 12 discrete ICs with the AD365 speeds design time; and the small 16-pin metal DIP saves valuable board space in portable instrumentation and on analogue I/O boards.

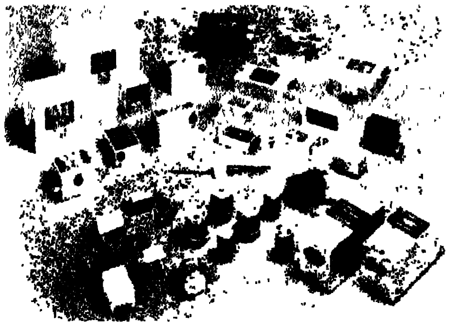


HYBRID DATA ACQUISITION AMPLIFIER

It offers a differential input stage whose minimum 90dB common mode rejection allows amplification of low-level transducer signals in the presence of common mode noise. The PGIA has four digitally programmable gains of 1, 10, 100 and 500. The ability to dynamically change gains permits the AD365 to condition both high- and low-level signals in multi-channel systems.
Contact: C.H. Krishnan & Associates Private Limited, Kamal Theatre Building, Safdarjung Enclave, New Delhi 110029.

FILTERS

The variety of RFI and EMI Filters manufactured by Belling Lee cater for interference in a very wide frequency spectrum of 10 kHz to 10 GHz and are suitable for electrical and electronic equipments, instruments and computers. These filters are suitable for DC, AC single-phase and three-phase equipments with current handling capacity to the extent of 800A.

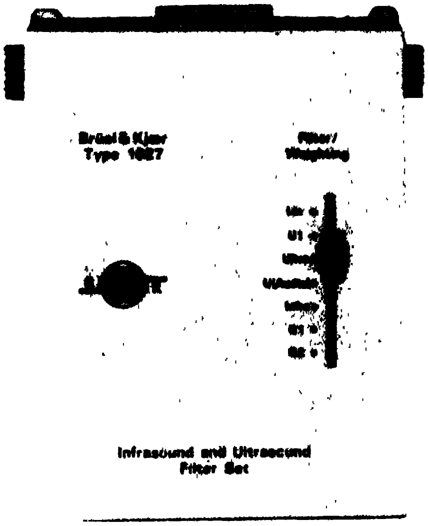


Contact: Echbee Corporation, 5th Floor, Kamer Bldg, 38 Cawasji Patel St, Bombay 400001.

INFRASOUND AND ULTRASOUND FILTER SET

This new Infrasound and Ultrasound Filte Set, Type 1627, from Bruel and Kjaer is intended primarily for use with the new modular precision sound level meter. Its six filter networks include G1 and G2 which allow infrasound measurements in accordance with ISO/DIS 7196.

Measurements of audible sound in the presence of ultrasonic noise are possible with filter network U (audio). The other filter networks are: U1, a proposed weighting which approximates the sensory perception of ultrasound; Ultra, a 12.5kHz high pass filter; and Infra, a 20Hz low pass filter. The filter set also has a linear setting. Included with the filter set is a special microphone adaptor which extends the useful low frequency range of the standard 1.27 cm microphone to below 1Hz.

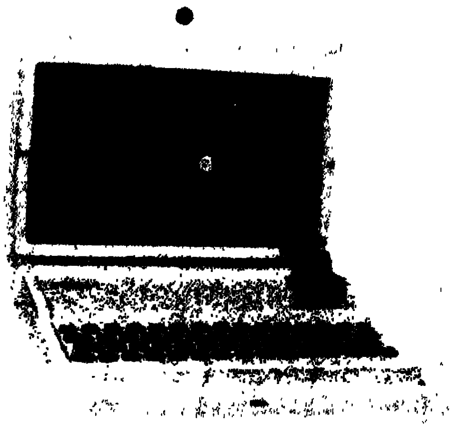


INFRASOUND AND ULTRASOUND FILTERSET

Contact: Jost's Engineering Company Ltd, 60 Sir Phirozeshah Mehta Road, Bombay 400001.

PORTABLE DEVELOPMENT SYSTEM

This PDS-1 Portable Microcomputer Development system is designed to support the well proven 1802 series 8-bit industrial CMOS microprocessor. Featuring an all CMOS design, and operating from built-in rechargeable nickel cadmium battery, it is truly portable. During use, it opens like a hand-held diary, with a 56-key silicon rubber ASCII key-



PORTABLE DEVELOPMENT SYSTEM

board on one side and the CPU board with a 16-character alphanumeric one-line LCD display on the other.

The PDS-1 has 8 kilobytes of firmware to aid the user in both hardware and software development. These resident ROM-based programs are: Utility, Editor, Assembler, and Memo-writer. During power-on, the PDS-1 initialies to the Utility mode.

Contact: Microtronics Systems Pvt Ltd, 8 Lorong Bakar Batu, 03-01 Kolam Ayer Industrial Park, Singapore 1334.

VME BUS SYSTEM

This VME Bus System with 68k CPU family is mounted in a special light metal rack which is waterproof and shock-resistant with 47.5 cm 6HI unit frame. This system is vehicle borne and ideal for use in rough terrain.

VME BUS SYSTEM

Contact: SPS Technical Electronic Pvt Ltd, 157 Housing Board Colony, Gulbarga 585103, Karnataka.

MACROMETER

This Macrometer, introduced by Geo-Hydro Inc., USA, is a portable receiver/computer that processes radio signals emitted by the global positioning system (GPS) satellites and computes the geodetic (i.e., x, y and h) co-ordinates of a point to an accuracy of 2 cm in all three coordinates. Station (point) occupation time is 2 hours and computations are completed in the field in 20 minutes.

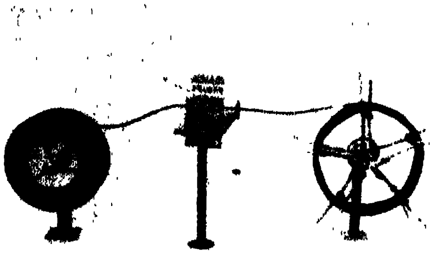
The equipment operates in all weather conditions and line of sight between points being surveyed is not required. In addition to its first order geodetic surveying capability, the macrometer is relatively insensitive to physical obstructions and electrical interference (e.g., buildings, trees and power lines) at the point being surveyed.

Its high accuracy is obtained by using the radio interferometric method which does not require the special satellite code information needed by other GPS instruments.

Contact: Toshni-Tek International, 267 Kilpauk Garden Road, Madras 600010.

WIRE 1 COMBINATION

This Wire 1 Combination of wire de-reeling, measuring, cutting and coiling equipment for the preparation of wire, tubing and small cables in the electrical and electronics industry consists of a medium-duty de-reeler, a measuring meter with cutter and stand, and a coiling device It can produce accurately measured and cut coils of material from bulk reels of wire, tubing and small cables. Coils of materials containing up to 300 metres may be prepared and the combination can accommodate wire and cable reels upto a maximum diameter of 47 5 cm and weight up to about 20 kgs.



WIRE 1 COMBINATION

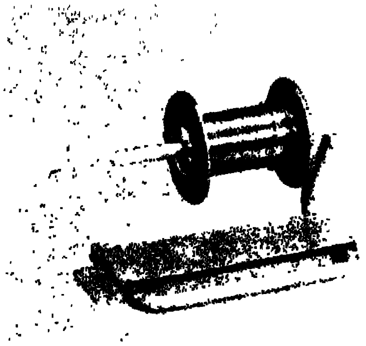
The three units that comprise the combination are all bench-mounted and easily adjustable for different sizes of material and specific applications.

Contact: The Eraser Company, Inc., P O. Box 4961/Oliva Drive, Syracuse, New York 13221, USA.

SPOOL HOLDER

This Model SA-1 Spool-Aid-Spool Holder is useful for holding small spools of wire and solder used in the electrical and electronics industry. The SA-1 accommodates a standard 2kg reel of solder and simplifies solder dispensing, thus avoiding waste. The unit can also hold small reels of wire used in assembly operations.

The base unit is attached to the work surface with four screws, and the reel holder slides easily in and out of the base to facilitate replenishing of material or location changes. It can hold reels up to a maximum width of 7.5 cm and maximum diameter of 10 cm, with a minimum arbor hole diameter of 0.6 cm.



SPOOL HOLDER

Contact: Rush Wire Strippers, P.O. Box 4961, Townline Road, Syracuse, New York 13221, USA.

TRANSISTOR, CAPACITOR FORMER

The Model WTCF-A Transistor and Capacitor Former is designed for use in the electronics industry by manufacturers of printed circuit boards It has adjustable tooling which permits the cutting and forming of radial lead TO-5, TO-18 and TO-92 transistors and disc capacitors with no tooling change The tooling is adjustable by the turn of a knob at the front of the machine

TRANSISTOR, CAPACITOR FORMER

It is air-operated by use of a foot switch, permitting the operator to load the machine with both hands The three leads of the components are cut to length and formed with a snap-in/stand-off configuration, all in a single operation. This operation ensures correct spacing of the component body from the board surface and eliminates the need to further trim the component legs on the soldering side of the board Forming eliminates the need for costly transistor pads and increases production, as components are not dislodged during handling, wave soldering, etc.

An adjustable stand enables it to be mounted either flat on the work surface or at angles up to 45°, to eliminate operator fatigue. Production rates of up to 7000 pieces per hour are possible

Contact: Wybar Electronics P O. Box 4961, Vincent Drive, Syracuse, New York 13221, USA.

SOLIDSTATE RELAY

This 'J' series Solidstate Relay ensures the advantages solidstate relays are meant to provide. With innovative design and imple-

SOLIDSTATE RELAY

mentation of advanced semiconductor processes, it offers the most advanced line of optically coupled solidstate relays available today

This series offers the advantages of logic compatibility (TTL/CMOS), zero turn-on/random turn-on, 2500V AC optoisolation and micro-second switching, totally potted to minimise the effects of humidity and vibration It has a capacity to handle up to 40 amps and 480V RMS

Contact: Electronic Relays (India) Pvt Ltd, No. 34/1A, 1st Main Road, Gandhinagar, Bangalore 560009

SOUND-OPERATED MODULE

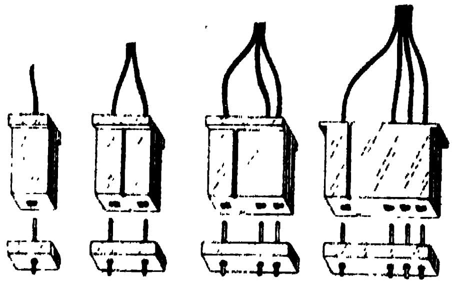
The Sound-Operated Switch Module is a wireless remote control switch Applications of this novel module are only limited by the user's imagination Electrical gadgets can be switched on/off from anywhere in the room without moving The module is activated /deactivated by sound signals like tapping feet, snapping fingers or clapping etc One clap switches on the gadget while another turns it off

SOUND-OPERATED MODULE

The module is a sound-sensitive electronic switch comprising a main-unit measuring only 45 × 51 × 14 mm, condenser microphone and relay, suitable for loads up to 500 watts It works on 6 volts DC which can be given either by four dry (1.5V) cells 6V battery pack or battery eliminator type aid Any electrical gadget up to 500 watts, can be connected to relay provided with the module.

The module can be added to any existing electrical appliance for its remote control operation. It is small enough to be added easily in the case of existing appliances *Contact: Elektro World, 48/B Harpal Hagar, Moradabad 244001.*

PCB CABLE CONNECTOR



PCB CABLE CONNECTOR

This PCB Cable Connector is most useful for [illegible]struments manufacturers. The flat connector, made in thermo plastic male pins in brass over silver plated and female pins in phosphor bronze over silver plated, can take up to 5 amps current. It is available from 1 to 7 pins.

The male part is put on PCB and female pins are provided with the desired length of wire (14/36 gauge) which saves the time for soldering of the female pins, thus enhancing production.

Contact: Jain Electronics, F-37 Nanddham Industrial Estate, Marol Maroshi Road, Andheri (E), Bombay 400059.

NEON LAMP

Industrial Electronic Engineers Inc., USA, introduces this energy-efficient, long life gas-discharge lamp for use in electronic displays and message centres. The lamp consumes only two watts of power but has a light output of over 4300 fl (measured on axis). The bright, neon-orange light can be read in direct sunlight, making it ideal in such applications as scoreboards and freeway message displays. Displays of virtually any size can be created when the lamps are installed in bayonet sockets mounted on 2.5cm centres.

NEON LAMP

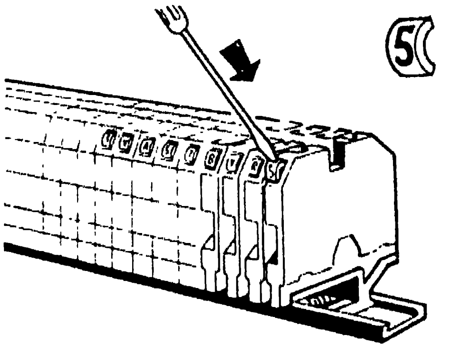
In addition to the low power consumption, the lamp has a rated life of 20,000 hours, at which time light output will have fallen to approximately half of original brightness. Maintenance is therefore simplified, as it ages gradually and predictably unlike conventional incandescent lamps.

Another advantage of neon hi-bright lamp is its rapid turn-on/turn-off time, which eliminates comet-trailing. The result is enhanced special effects, such as animated graphics and moving messages. The lamp requires 155V DC at 13 mA for operation.

Contact: IEE Industrial Products Division, 7740 Lemona Avenue, Van Nuys, CA, 91405, USA.

TERMINAL BLOCK MARKER

This Terminal Block Marker is made of elastic and stable thermoplastic which is self-extinguishing and can withstand temperatures up to 85°C. It can either be slid into the terminal block tag slots before the terminals are mounted in the assembly or easily pressed home into the slots after terminal banks have been built. The tags are pre-cut and produced in strip form.

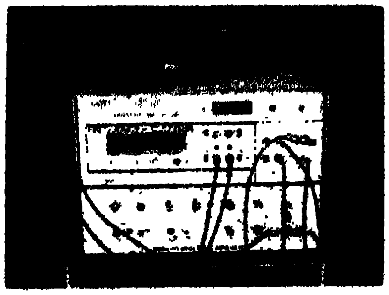


TERMINAL BLOCK MARKER

Contact: Novoflex Cable Care Systems, 7th Floor, Block A 14, Chatterjee International Centre, 33A Chowringhee Road, Calcutta 700071.

CUTT-INSTRUMENT

This CUTT (compensated ultrasonic timer technique) Instrument is a solidstate digital instrument for measuring travel time and wave velocities in solids (including lossy media) and is the first one of its kind. The instrument utilises a direct pulse for opening an electronic gate from a compensating set of no-delay acoustic transducers, and another delayed pulser from a second set of acoustic transducers to close the gate of an electronic timer/counter, displaying the gated interval digitally with a high degree of precision.



CUTT-INSTRUMENT

The instrument finds a variety of applications in studying the sound wave velocities under varying environmental conditions relating to the fields of geology, geophysics, civil and mining engineering and material sciences.

Contact: Anushya Electronics Pvt Ltd, 1-1-714/C/3, New Bakaram, Gandhinagar, Hyderabad 500380.

BOOK Reviews

The Illustrated Dictionary of Electronics—3rd Edition

By Rufus P. Turner and Stan Gibilisco; published by TAB Books Inc., USA; pages 595 (18 cm × 23 cm); soft cover; price: US $ 21.95.

This completely revised, updated and enlarged 3rd edition contains over 27,000 definitions of vital electronics terms, acronyms and abbreviations This edition is thoroughly updated in the sense that more than 2000 new terms and definitions, currently in use in modern electronics practice, have been included With a generous dose of essential drawings, diagrams and tables, the book will be of immense help to both professionals and beginners in the fields of basic electronics, electricity, communications and computers

—B V R

The 555 IC Project Book

By Robert J. Traister; published by TAB Books Inc., USA; pages 217 (13 cm × 21 cm); soft cover; price: US $ 11.95.

The 555 timer is one of the most popular and versatile ICs on today's market, and also one of the least expensive! It's an ideal choice for the novice just beginning to work with integrated circuits and is so powerful and multifaceted that it is also used in the most sophisticated industrial frequency counters and microcomputers With this well-documented project guide, hobbyists can begin to use the 555 timer IC in a variety of useful projects that are both easy and fun to put together Some of the projects included are· a code practice oscillator, an electronic test probe, and a simple intrusion alarm Also included are two power supply projects that power the 555 IC circuits without using costly batteries

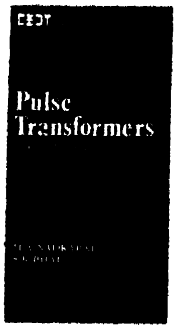
Guidance on basic electronic building techniques and the fundamentals of electronic measurement as well as in-depth information on the configuration and usage characteristics of the 555 itself are provided. And, of particular importance to hobbyists, there are details on how to obtain electronic components and a listing of different manufacturers component numbers for the 555 and the 556 (a dual 555 IC in a single package)

Hand Book on Electronic Industries

By Gulshan Kumar; published by Small Industry Research Institute, Delhi; pages 678 (15 cm × 24 cm); hard cover; price: Rs 150.

Electronics industry is such an essential component of the national economy that to attain self-reliance calls for the unimpeded growth of the electronics industry, particularly the professional industry The book under review gives information on different kinds of projects, their market potential financial viability, technical aspects and manufacturing details to persons wanting to start an industry and professionalise in the same The book highlights the latest manufacturing and assembling techniques circuit diagrams cost analysis, market survey and expected return on investment of more than 100 most profitable electronics items Addresses of raw materials and machinery suppliers and manufacturers are also featured

- B V R



Pulse Transformers—Design and Fabrication

By M.A. Nadkarni and S.R. Bhat, published by Tata McGraw-Hill, New Delhi; pages 158 (18 cm × 25 cm); hard cover; price: Rs 27.

Design engineers in the electronics industry and students of electronics and electrical engineering will find a lot of useful information in this book Various design aspects and material properties of pulse transformers are considered and some practical examples cited to help get a clear understanding of the subject The book also contains mathematical analysis and transformer models to provide a foundation for the behaviour of pulse transformers in complex circuits Different core materials the technology involved during fabrication, and testing and quality control measures are also discussed

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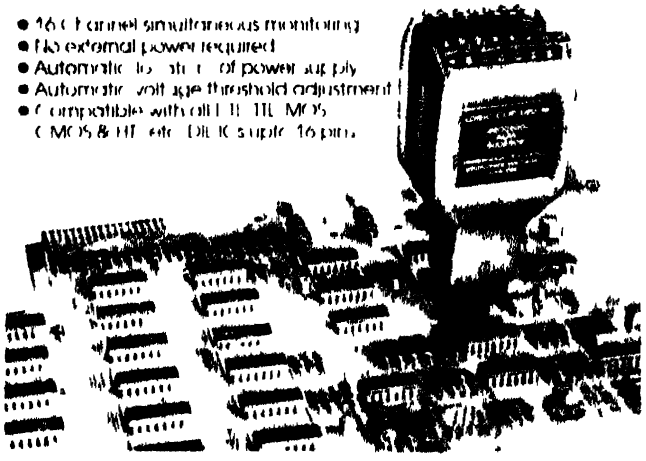

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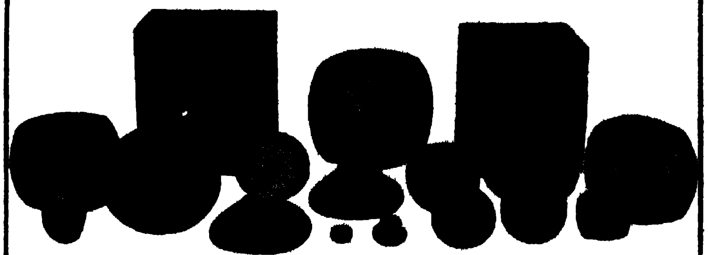

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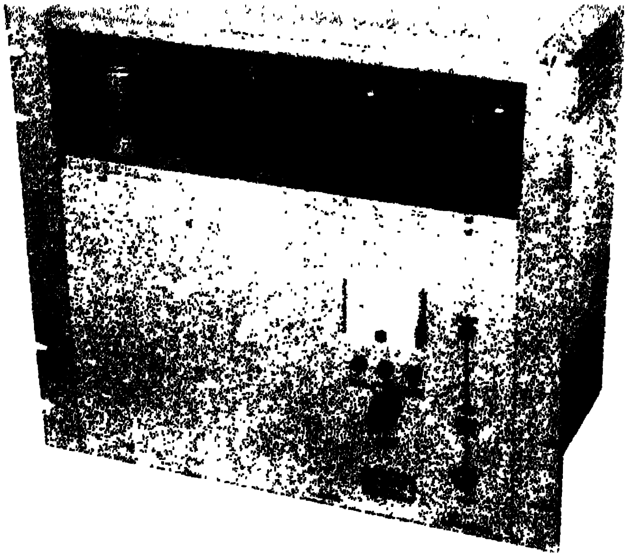

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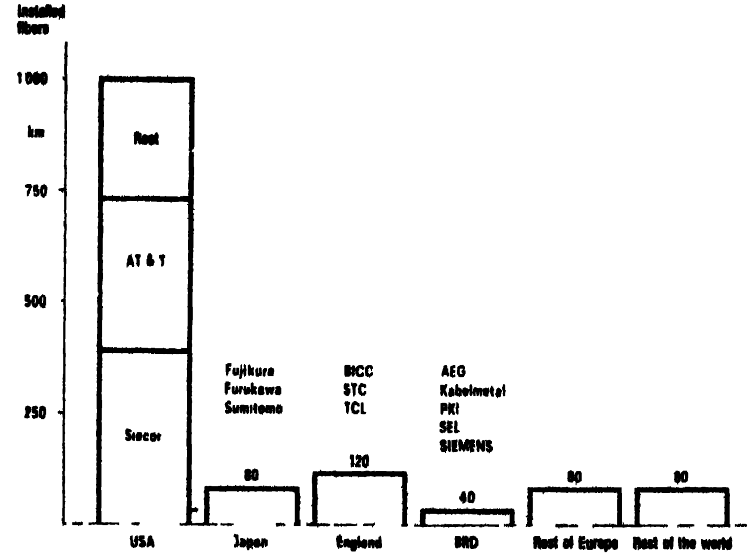
Company Profiles

Record production of 'Crown' TV sets

The production of Crown TV sets has shot up by 80 per cent during 1985—from 134 000 TV sets produced in 1984 to over 238,000 sets in 1985 This way, Crown has established itself as India s largest selling TV No other Indian TV brand has achieved this figure so far

The popularity of Crown TV sets had been increasing steadily since last few years because of the company s policy to produce quality goods It will not therefore be surprising if the company produces over 300,000 sets during 1986 which it is already targeting for

Before the end of 1985, more than three-fourth of a million Crown sets, both black-and-white and colour, had been produced So before 1986 ends, the population of Crown TV sets in India would exceed one million



World Market for Optical Waveguides in 1985

Courtesy Siemens, West Germany

STC's latest optical link

STC Telecommunications officially handed over a 160km optical fibre link to the minister of Petroleum at Loni, near Pune on February 1

The 140 megabits per second single-mode optical system is the first of its kind in India and provides a high capacity communications link for the Hindustan Petroleum Corporation It will be used to connect its refinery in Bombay with an oil distribution centre near Pune, with both manned and remote pumping stations being connected along the 160km pipeline

Primary use of the system will be to remotely operate equipment within the pumping stations, enabling Hindustan Petroleum to monitor the status and operate motorised valves to control oil flow The capacity of the optical system will enable speech, data and telex facilities also to be included

A cable containing four single-mode fibres was installed in conjunction with the laying of the pipeline The cable manufactured by STC is designed for direct burial into the ground and uses an outer steel armouring to protect the optical fibres

STC is the leading telecommunications and computer company in the Uni- [illegible] Kingdom It has seven principal [illegible] covering telecommunica- [illegible] computers under the recently [illegible]ted ICL, electronic components, home electronics and research and development STC Telecommunications is one of the seven management companies and concentrates on designing and manufacturing telephone exchanges transmission systems, telephone and industrial cable, printed circuit boards, telephones, teleprinters and other data, and communications terminals

FM/AM modulation meter from English Electric

The English Electric Company India Ltd, Madras, has pioneered an automatic modulation meter—the first of its kind in the country—using sweeper technology and comprising high technology components. Priced around Rs 22,000, the instrument helps to denote the percentage of sound modulation taking place in transmission and in reception.

Plans are afoot to make the instrument suitable for measurement with computer control.

The instrument—FM/AM [illegible] Meter TF [illegible]—has been [illegible] primarily for the servicing [illegible] tion line and testing of [illegible] transmitters. Its [illegible] mostly on fixed and [illegible] tion band. Special [illegible] given to the [illegible] accessories [illegible] of mobile equipment

Among the special features of the instrument are automatic tuning over the frequency range 9 to 12 5 MHz and 18 to 1000 MHz, automatic level control within a specified radio frequency level, panel lamps to indicate when the radio frequency input is too high or low (leading to distortion) The instrument uses high technology components like varactor diodes, hot carrier diodes, honey comb filters, etc for detection of modulation Also, measurements can be made on FM transmitter of both positive and negative deviations at modulating frequencies of 50 Hz to 9 kHz On AM transmitter, depth measurements up to 95 per cent at modulating frequencies between 50 Hz and 9 kHz can be made at carrier frequencies up to 400 MHz Peak or trough indication can be also selected by a switch

Keltron's consultancy for Andhra

[illegible] State Electronics [illegible] Corporation Limited, has [illegible] instruments and introduction of computers for improving productivity in tea industry and manpower development for R&D and servicing etc.

Amtron has desired to purchase knowhow for 42 products developed by Hartron at its R&D centres. Hartron has also agreed to pass on its experience in the field of servicing and maintenance of equipment in government institutions like hospitals and polytechnics by setting up a servicing centre to cater for the state's specific requirements.

Jalex to make professional connectors

Jay Electric Wire Corporation Limited and Molex International Inc., USA have signed a joint venture agreement to manufacture a range of professional grade electronic connectors. The joint venture envisages technical and equal financial participation by Molex and Jay, and a new company—Jalex Connector Systems Limited—has already been incorporated to implement this project which is expected to go on stream by the later half of this year.

Jay Electric organised a seminar on application of connectors and modern trends in their usage in the electronics field The seminar was conducted by Mr George Pill, Molex training manager and Mr Ivor Redmonde, technical adviser to president of Molex Intl Inc. with video presentation on February 1 in New Delhi. It was a good opportunity for technical people to actively interact with these two experts, who have been in the connectors field for the past several years.

Molex is a multinational with 35 plants spread over 16 countries of four continents. It produces over 20,000 items. The new Indian factory is being set up in Keonics City near Bangalore.

Pressfit connectors from Pasadena

The Pasadena Group of Companies is going to introduce backplanes and pressfit connectors for the first time in the country. The group has set up extensive and modern facilities for the manufacture of these items with US collaboration, taking packaging techniques in electronic equipment in India to a higher level of sophistication.

Pressfit is the interface fitting of an electrical contact into a PTH of a PCB. The result is a gastight corrosion-proof connection with high reliability. This can be achieved either by a solid pressfit or complaint pressfit, depending upon the shape of contact and movement of PTH. The advantages of pressfit connectors are more apparent on multilayer PCBs where soldering is not desirable.

Magnavision to enter capital market

Magnavision Electronics, an existing company, will enter the capital market shortly with a paid-up capital of Rs 8 million. The promoters will contribute Rs 3.2 million and the balance will be offered to the public.

The amount raised through this public issue will be utilised to finance its expansion programme and to meet its long-term working capital needs.

The company has entered the business of advanced technologies and electronics. It is now manufacturing black-and-white as well as colour TV sets and marketing computers and electronic components. It is also planning to manufacture mini and microcomputers and electronic PABX.

The company's turnover for a period of 12 months up to the end of 1985 is expected to be about Rs 30 million and the directors hope to pay a dividend for the current year.

ECIL to make supermini computers

The Electronics Corporation of India Limited (ECIL) plans to manufacture supermini and mainframe computers in the country. While Norsk Data A.S., Norway has been identified as the foreign collaborator for the first project, search is on for an appropriate collaborator for the second. Honeywell Bull of France and Control Data of USA are the two bidders in the race after shortlisting of tenders

The 32-bit supermini computers to be manufactured at ECIL plant in Hyderabad, would have hardware and software features for handling scientific, business and real-time applications. To start with, ECIL will import 20 systems from Norsk Data. But in 1986-87 itself, ECIL is confident of achieving 50 per cent indigenisation and further reducing dependence on imported components to 30 per cent as early as 1977-88.

ECIL has crossed the Rs 800 million turnover mark in 1985-86 and is expected to end the year with a turnover between Rs 1000 and Rs 1200 million. This would mark a 50 per cent growth rate

The company. plans to invest Rs 800 million during the seventh Plan period. Of this Rs 110 million has been earmarked as budgetary allocation for 1985-86 while that for 1986-87 is Rs 120 million

L&T to make EPBAX

Larsen and Toubro Limited will manufacture electronic private automatic branch exchanges (EPABX), incorporating the latest technology, in collaboration with Jeumont Schneider of France as reported briefly in the February issue. The state-of-the-art technology in these EPABX includes time division multiplex pulse code modulation (TDM-PCM) and pulse amplitude modulation (TDM-PAM). These modulation techniques enable the system to support a very high calling rate as in large industries and hotels, and provide high quality of speech.

To be manufactured at L&T's Mysore works, the equipment has many modern features such as restrictive direct access to trunk lines, call hold and transfer, consultation hold, automatic call-back on busy or free extension, three-way conferencing and third party override—all features available to users even with existing rotary dial telephones Abbreviated dialling, memory and last number redial are some additional facilities offered with pushbutton instruments.

Connections are made by digital switching using highly integrated memory circuits. This ensures much larger traffic capacity. Diagnostic capability up to card level is built into the equipment. These exchanges also have facilities for data transmission and for interaction with computers.

GDEL tie-up with Casio

The Gujarat Data Electronics Limited (GDEL) will soon manufacture electronic musical instruments for the first time at Gandhinagar, in technical collaboration with Casio of Japan. GDEL is a joint sector company set up with a share capital of Rs 10 million by the state-owned Gujarat Communications and Electronics Limited (GCEL) along with an entrepreneur from Bombay, with the Gujarat State Fertilisers Company as co-promoters.

The company plans to enter the market with three models of instruments by May this year. It will also produce two models of electronic cash registers which will be introduced in the market later this year.

LICENCES AND LETTERS OF INTENT

The following licences and letters of intent were issued to electronics firms under the Industries (Development & Regulation) Act, 1951 during the month of October 1985

Name & Address of the Applicant and location of the undertaking (1)	*Date & type of licence* (2)	*Article* (3)	*Quantity per annum* (4)
LICENCES			
Usha Microprocess Controls Ltd 105, Chiranjiv Tower 43 Nehru Place New Delhi 110019 (Distt Faridabad-Haryana)	10 10 85 (SE)	Minicomputers and microprocessor based systems including process control systems	Rs 60 million
Electronics Corporation of India Ltd Cherlapalli Hyderabad (Distt Ranga Reddy Andhra Pradesh)	10 10 85 (SE)	Colour TV receiver sets	80 000 nos
Kalyani Telecommunications & Electronics Ltd Flat No 9 & 10 2nd Floor Priyadarshan Co-op Housing Society Koregaon Pune 411001 (Distt Pune Maharashtra)	10 10 85 (NU)	Colour TV receivers sets	50,000 nos
Wipro Information Technology Limited 88 Mahatma Gandhi Road Bangalore 560001 (Mysore-Karnataka)	22 10 85 (SE)	Minicomputer microprocessor based systems	Rs 400 million (after expn)
Larsen & Toubro Ltd L&T House Ballard Estate Bombay 400038 (Mysore-Karnataka)	30 10 85 (NU)	1 Standard/Mini (Floppy Disc Drives) 2 Dot Matrix Printers	7,500 nos
LETTERS OF INTENT			
Himachal Pradesh State Development Corporation Ltd Saligram Bhawan Khalini Simla 2 (Backward Distt Himachal Pradesh)	4 10 85 (NU)	1 Direction finder HF/VHF and UHF and accessories 2 HF/VHF UHF communication system MN 3 Radio relay 100 to 400 MHz 4 Voice and data recorders and Chart displays 5 Head sets and microphones 6 Exciters & amplifiers of all types of HF/UHF, VHF and higher band	20 nos Rs 30 million 100 nos 250 nos 700 nos 250 nos
Himachal Pradesh State Electronics Development Corporation Ltd Saligram Bhavan Khalini Simla 2 (Backward Distt Himachal Pradesh)	4 10 85 (NU)	Electronic rural automatic exchange	50 000 lines
Nomian H Mirwala 26 Main Road Karpagam Avenue Madras 600028 (Madras Tamil Nadu)	4 10 85 (NU)	Magnetic tape heads	2 5 million nos
Continental Device India Ltd C-120 Naraina Industrial Area New Delhi 110028 (Distt Ghaziabad Uttar Pradesh)	4 10 85 (NU)	Car stereo players and radio cum cassette players	50,000 nos
L N Saraf 101 Padam Tower-1 5 Rajendra Place New Delhi 110008 (Backward Distt-Rajasthan)	4 10 85 (NU)	Colour TV receiver sets	50 000 nos
Taylor Instrument Company (India) Ltd 14 Delhi-Mathura Road P O Amarnagar Faridabad 121003 (Faridabad Distt-Haryana)	4 10 85 (NA)	Process simulators for process control application	20 systems
Rajasthan State Industrial Development & Investment Corporation Ltd Udyog Bhavan, Tilak Marg Jaipur 302005 (Ajmer-Rajasthan)	8 10 85 (NA)	1 Digital thermometer 2 Electronic blood pressure unit 3 Electronic stethoscope 4 Hearing aids 5 Pacemakers 6 Artificial stimulator 7 Alcohol tester 8 Digital salt meter	500,000 sets
Indian Duplicator Co Ltd 114 Dr Lal Mohan Bhattacharjee Road Calcutta 700014 (Ranga Reddy Distt-Andhra Pradesh)	8 10 85 (NA)	Word processing systems	3000 nos
Mekaster Consultants Pvt Ltd 506 Ansal Bhavan 16 Kasturba Gandhi Marg New Delhi 110001 (SEEPZ-Maharashtra)	10 10 85 (NU)	Video telex/teleprinter	1st yr 1200 nos 2nd yr 3600 nos 3rd yr 4800 nos 4th yr 6000 nos 5th yr 7200 nos
Aptek Computers Pvt Ltd 113 Jolley Maker Chambers No 2, Nariman point Bombay 400021 (Distt Baroda-Gujarat)	11 10 85 (NU)	Electronic type teleprinters	2000 nos
Solid State Devices India 6 2 14 Raj Bhavan Road Hyderabad 500004 (Distt Medak Andhra Pradesh)	22 10 85 (SE)	Semiconductor devices	50 million nos (after expn)
V K Sureka B 231, Okhla Industrial Area, Phase-1 New Delhi 110029 (Distt Ghaziabad-Uttar Pradesh)	24 10 85 (NU)	Colour TV receiver sets	50,000 nos
M N Sankara Narayanan SREYAS Calicut 700011 (Distt Trivandrum-Kerala)	24 10 85 (NU)	Colour TV receiver sets	50,000 nos
Computech International 77/24 Hazra Road Calcutta 700029 (Backward Area-West Bengal)	29 10 85 (NU)	Facsimile transreceiver	2000 nos
Gujarat Data Products Pvt Ltd 1 Shrinath Complex (4th Floor) 18, S D Road Secunderabad 500003 (Distt Medak-Andhra Pradesh)	29 10.85 (NA)	Computer peripherals, winchester disc drives	Rs 45 million
Gujarat Data Electronics Ltd C/o Gujarat Communications & Electronics Ltd Anurag Commercial Centre Race Course Baroda 390005 (Gandhinagar-Gujarat)	29 10 85 (NU)	Electronic musical instruments excluding electronic toys	25,000 nos
Gujarat Communications & Electronics Ltd Anurag Commercial Centre, Baroda 390005 (Gandhinagar-Gujarat)	29.10.85 (NA)	1 PCM mux tester 2 Fault locating tester 3 PCM cable test set 4. Digital transline analyser	1200 nos (100 nos each except for instruments marked 'with' which

(1)	(2)	(3)	(4)
		5 Digital psophometer 6 550MHz oscilloscope 7 Microwave link analyser* 8 Pattern generator/error detector* 9 Power meter* 10 Spectrum analyser* 11 18GHz frequency counter* 12 Vectorscope wave form monitor & other similar test instruments	shall be 60 nos each)
D S Nanda 55, Community Centre East of Kailash New Delhi 110065 (Distt Ghaziabad Uttar Pradesh)	29 10 85 (NU)	Minicomputer/micro processor based systems	Rs 100 million
Bharat Heavy Electricals Ltd 18-20, Kasturba Gandhi Marg New Delhi 110001 (Bangalore Karnataka)	29 10 85 (NA)	Minicomputer/micro-processor based programmable systems	Rs 350 million
Viptron 16, Ring Road, Lajpat Nagar New Delhi 110024 (Ghaziabad Uttar Pradesh)	29 10 85 (NU)	1 Matrix printers 2 Line printers 3 Floppy discs 4 Winchester disc drives	1250 nos 200 nos 600 nos 150 nos
Kerala State Electronics Development Corpn Ltd Koltron House, Vellayambalam Trivandrum 695033 (Distt Calicut-Kerala)	29 10 85 (NU)	Colour TV receiver sets	50,000 nos
Rajesh Kumar S S Enterprises 12-A Motilal Nehru Regional Engineering College Indl Estate Allahabad (Distt Allahabad-Uttar Pradesh)	29 10 85 (NU)	Public telephones (coin operative)	5000 nos
Tarun Mohan H No 202, Sector 36-A Chandigarh (Distt Solan-Himachal Pradesh)	29 10 85 (NU)	Sheet metal components for electronics and automobile industries (excluding components reserved for small scale sector)	2400 tonnes
M R Narayanan Kryonix, Kowdiar Trivandrum 695003 (Trivandrum-Kerala)	31 10 85 (NU)	1 Microprocessor based terminal convertors (for protocol convertor for linking computer terminals etc) 2 Modems 3 Daisy wheel printers 4 In-circuit emulators (for microprocessor based system development)	Rs 50 million

LETTERS OF INTENT CANCELLED

Name of Undertaking/Location	*IL date*	*Article*
AMPS Electronics **14, Udadhi Tarang** **Junu Tara Road** **Bombay 400054** **(Maharashtra)**	1 11 83 (Cancelled)	CTV receiver sets
S Kakshmi (KM) **4, Sunehri Bagh Road** **New Delhi 110011** **(Uttar Pradesh)**	28 12 83 (Cancelled)	CTV receiver sets
Kerala State Electronics **Development Corpn Ltd** **Keltron House, Vellayambalam** **Trivandrum 695001** **(Kerala)**	12 9 80 (Cancelled)	Two-way radio communication and allied equipment
Karnataka State Electronics **Development Corpn Ltd** **'Emlyn Haven', Race Course Road** **Bangalore 560001** **(Karnataka)**	9 4 79 (Cancelled)	Various types of antennae incl accessories

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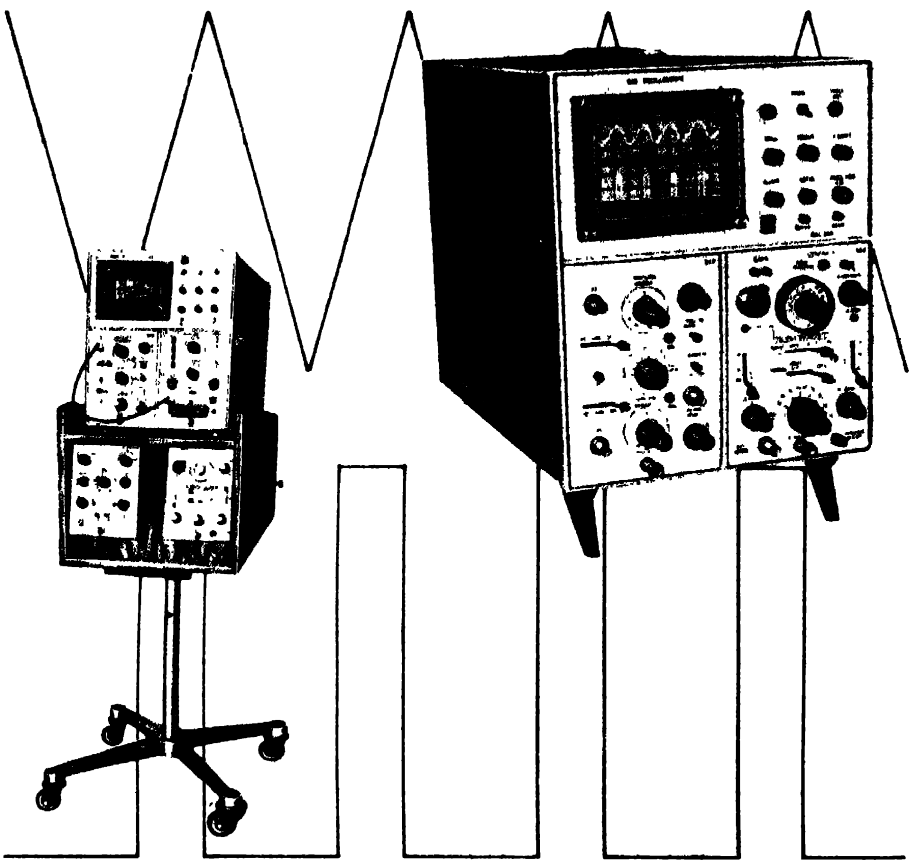

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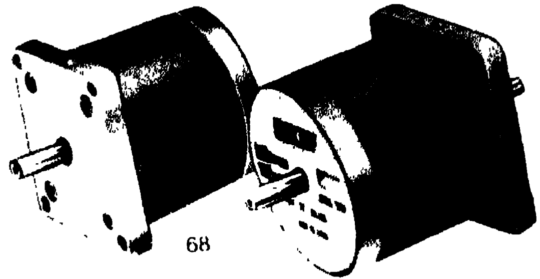

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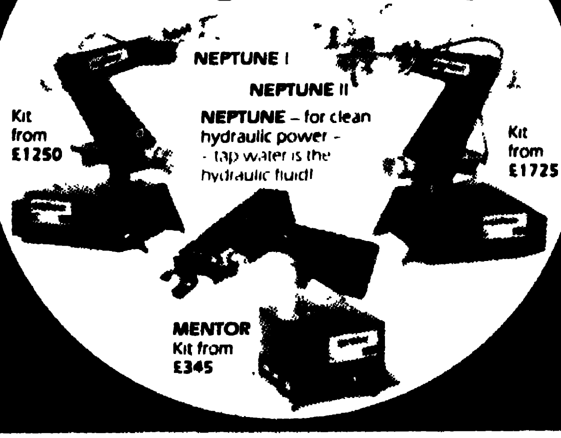
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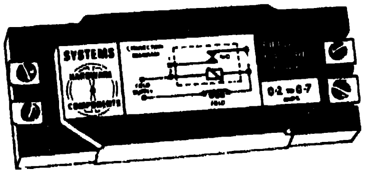

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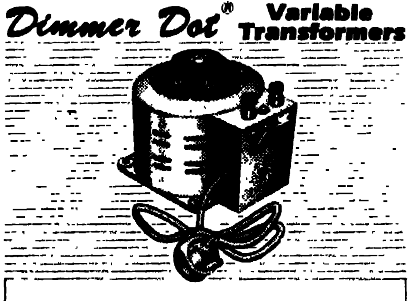

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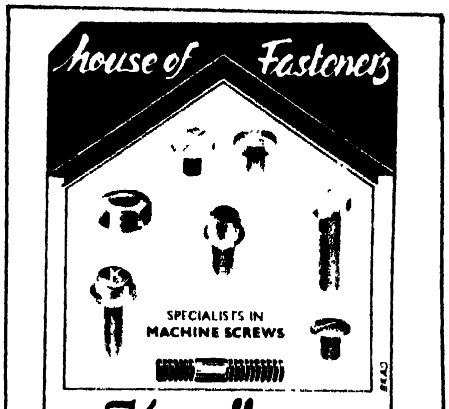

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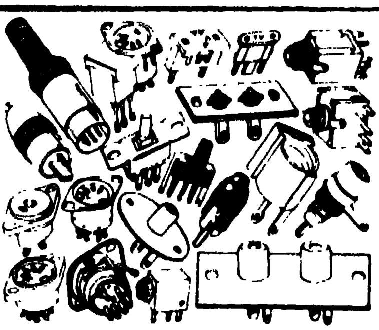

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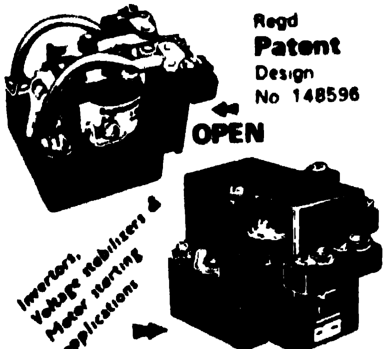
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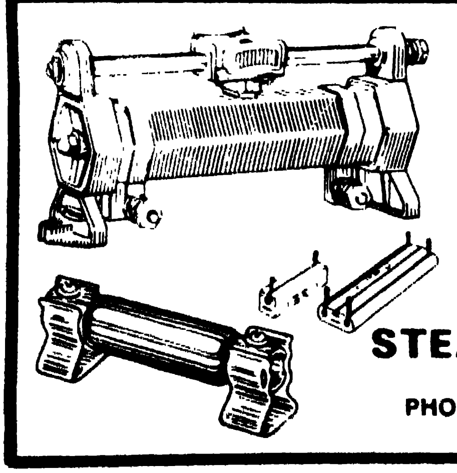

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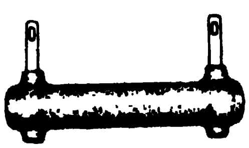

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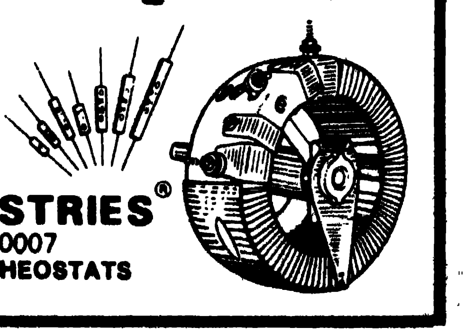

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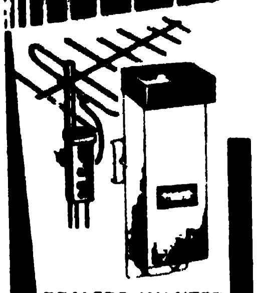
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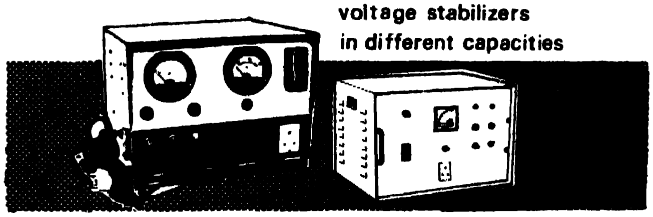

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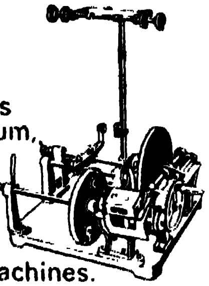

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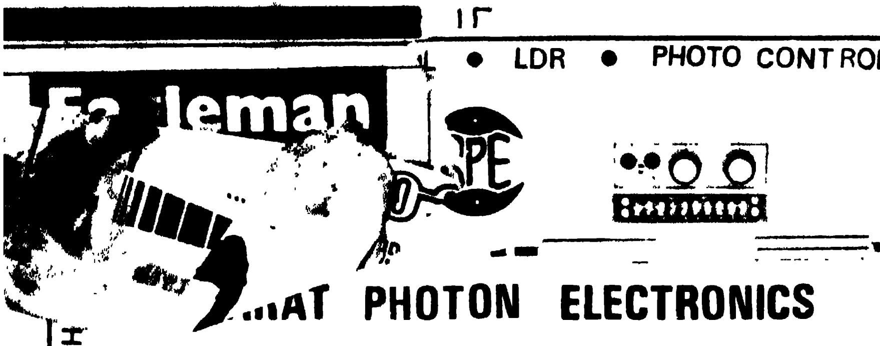

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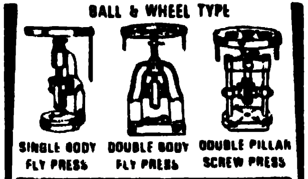

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Advertisers' Index

ASE Ltd (Systronics)	110
Alfa Products	104
Allied Publishers	73
Amar Radio Corporation	6
Andhra Electronics	72
Aradhna Electronics	27, 71
Arun Electronics	78
Associated Electrical Agencies	7
Atlas Radio & Electronics	98
BPL-India	37
BT Solders	63
Bajaj Electricals	59
Bakubhai Ambalal	49, 89
Balaji Engineering	90
Brisk Electro Sales	65
Business Promotion Bureau	10
CTR Manufacturing	58
Champion Electronics	30
Component Technique	48
Computech Associates	38
Cresta Instruments	72
Cycl-O- Computers	73
Desai Electronics	49
Dominion Radios	72, 78
ET&T	4
Electronic Instruments & Controls	28
Elnova	105
Emco Electronics	44
Filcon Electronics	61
Fluxall	78
Geeta Electronics	8
ITT, West Germany	IV Cover
Inde Associates	5, 9, 12
Integral Systems	81
J J Electronics	72
J R Controls	73
Kadimi International	56
Kusum Sales	104
Kwality Electricals	49
Labgear India	81
Lakshmi Electrical	62
Leader Electronics, Japan	36
Leader Electronics, Delhi	90
MU Electronics	82
Masibus Electronics	48, 55
Meco Instruments	81
Mehta Engineering	39
Mekasonics India	104
Microtronics, Singapore	45
Motwane Manufacturing	29
Nippon, Japan	28
Oswal Electronic	64
Paramount Electronics	28, 82
Pioneer Electronics	77
Poonam Industrial Research	3
Professional Electronics, Delhi	89
SGS Semiconductor, Singapore	II Cover
Saini Electronics	104
Satellite Systems	6
Scientific Mes-Technik	57
Series Audio Systems	III Cover
Southern Batteries	61
Stovec Screens	15
Technology & Research Associates	110
Texonic Instruments	73
Time Engineers	89
Trans Marketing	16
Unique Systems & Control	118
Vasavi Electronics	8
Vishal Agencies	97

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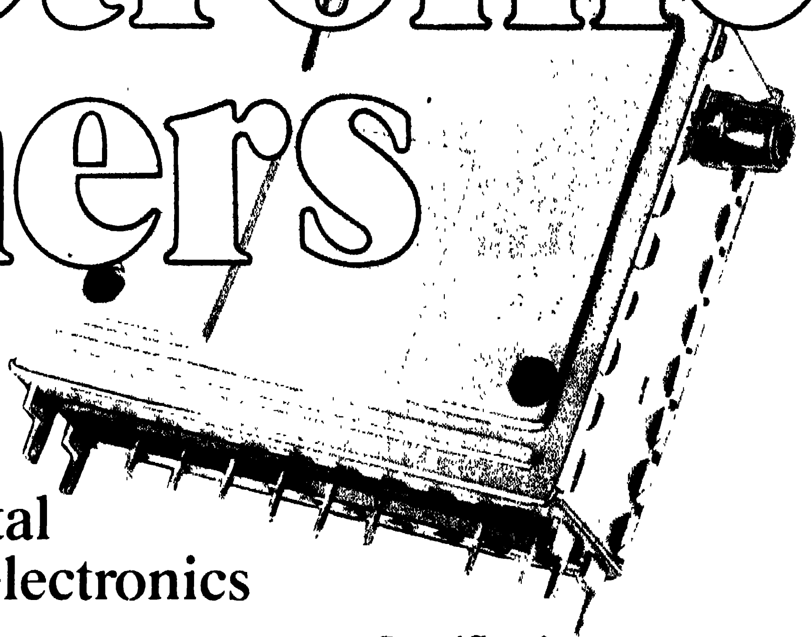

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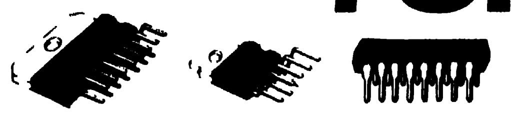

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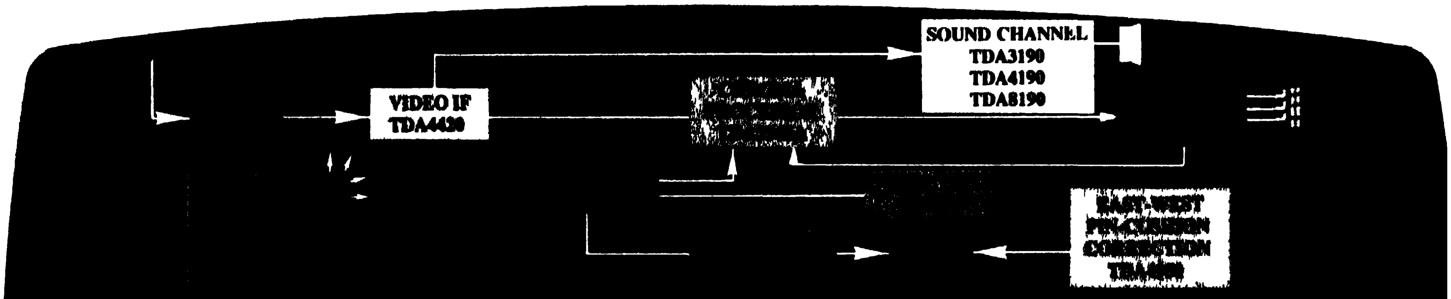

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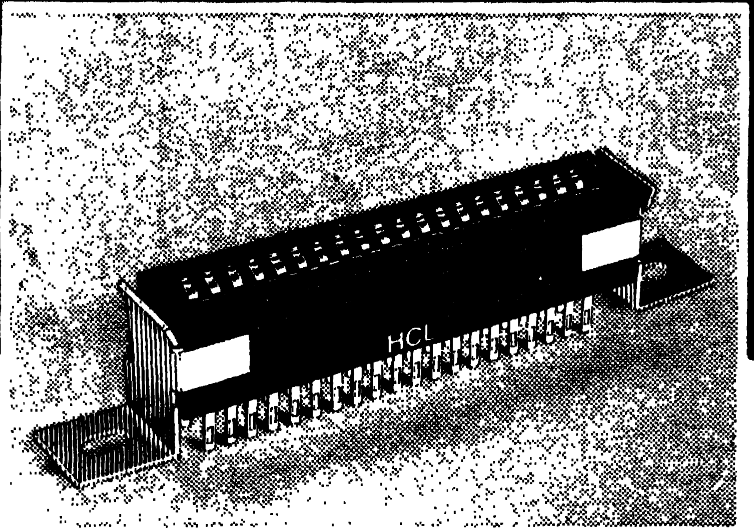

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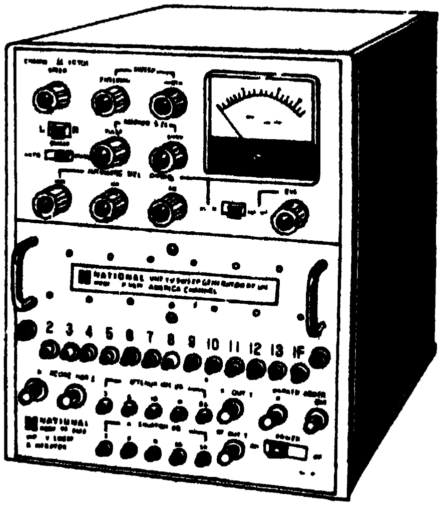

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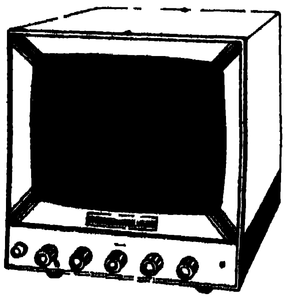

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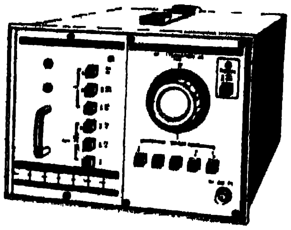

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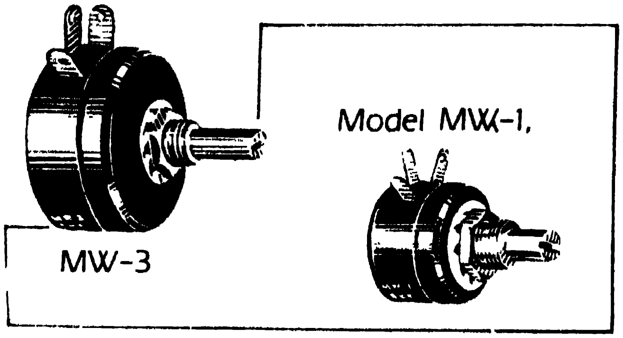

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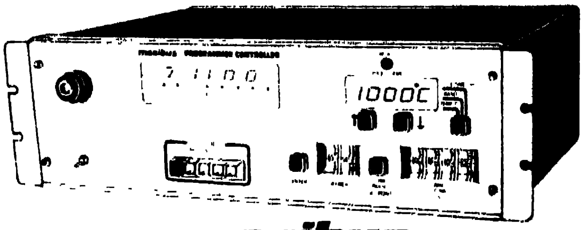

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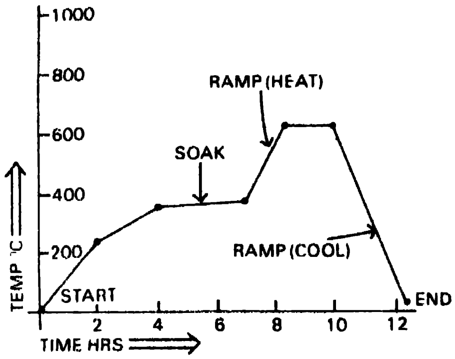

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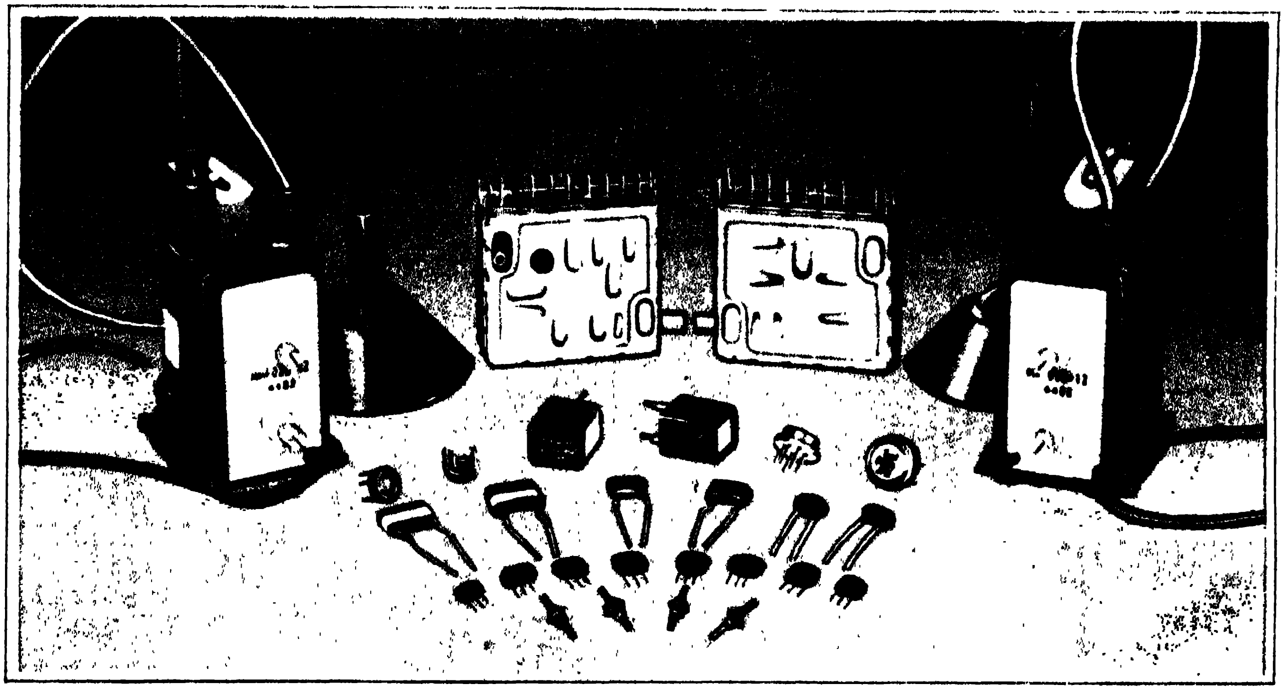

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contents

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FOR YOU

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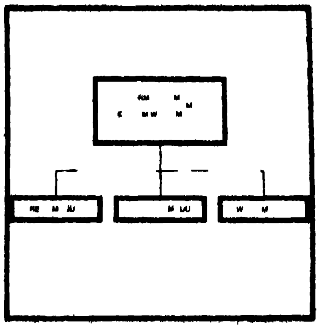
Electronic Typewriters' Guide

21 Most organisations are increasingly switching over to electronic typewriters attracted by the manifold advantages they offer to the modern offices With the various brands vying for a prominent place in the market EFY's guide will help prospective buyers in selecting an appropriate machine suited to their particular requirements

—An EFY Report

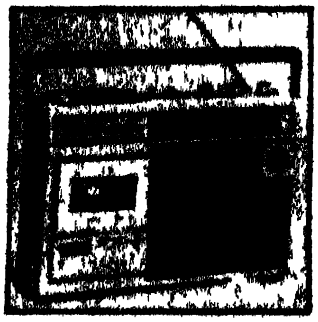


Structured Programming

55 For data processing to be really cost-effective especially for business applications, there is need for programs which can be easily maintained, modified and debugged as and when required The programming discipline called structured programming described in this article will help programmers in clarifying doubts about the concept

—Suresh K Basandra

Radio Cassette Recorder



79 Audio projects are always appreciated by every electronics enthusiast from the beginner to the professional Here is a long-awaited project on radio cassette recorder (two-in-one) for EFY readers with a sensitive recorder and a choice of MW or SW radio

—S Das Gupta

21 Electronic Typewriters Guide
—An EFY Report
31 European Electronics Market Elcina's View Point
35 The Saga of Crystals Part II
—A V Jacob
46 Comparative Study of Computer Languages Part X
—R Ramaswamy
55 Structured Programming
—Suresh K Basandra
65 Crossover Networks Part II
—Jasvinder Osan
70 Automatic Tank Filling Cum Pump House System
—Y M Rama Rao, A S Sreenivasan and A K Raveendran
79 Radio Cassette Recorder (Two-in-One)
—S Das Gupta
88 Interview with Mirivoj von Somogy
—An EFY Report
93 Three-dimensional Viewing of Graphic Displays
—Arthur Fryklit

FEATURES

13 Letters
15 What's New
43 Computer Corner
70, 79 Construction
74 Electroons
91 Circuit Ideas
99 Product Profiles
103 Book Reviews
106 Company Profiles
108 Facts & Figures
111 Electronics Mart

Throughput in PCB assembly machines lowers assembly cost

PCB assembly machines of Hollis Automation Inc., U.S.A., give high throughput, are rugged for production floor handling and reliable to provide you trouble-free operation with consistent results year after year.

ASTRA is an automatic wavesoldering machine for continuous high volume soldering of PCB's. It is available in four solder wave widths : 305 mm, 406 mm, 457 mm, 610 mm. "Z" solder wave equipped with oil-intermix in ASTRA enables the user to select oil-intermix or dry soldering as desired. In either mode, ASTRA provides superb results on routine or high-density PCB's including multilayers and unusual geometries. It solders surface mounted devices with equally superior results with optional dual solder wave.

GBS Mark III is a unique high productivity wavesoldering and debridging machine in PCB industry. Its precisely engineered microprocessor-controlled airknife clears solder bridges, icicles and unwetted solder joints on difficult-to-solder PCB's. Its useable wave-width is 610 mm. The machine solders 1230 linear meters of PCB's automatically per 8-hour shift when operated at 3 meter/minute speed.

SCS 150 is a high production fully automatic system for long lead locking, cutting and wavesoldering of PCB's with width up to 406 mm. Unclinched straight-through lead wires in high-density PCB's offer advantages of labour and processing saving. The patented Hollis Stabilizer method of locking unclinched lead wires into PCB's for accurate in-line mass cutting before wavesoldering, lowers assembly and soldering costs.

Holli Clean 16 is an automatic aqueous cleaning and drying machine to de-flux PCB's (up to 406 mm width and 51 mm high) in a continuous process. Though highly compact (occupying mere 2.8 square meter of floor space), Holli Clean 16 combines washing, rinsing and drying stages normally found in large machines.

The free standing Holli Cutter 400 works as a unit of total conveyorised system or off-line alone. It trims all lead wires precisely on even most densely populated PCB's (with width up to 406 mm) in a single pass. Holli Cutter 400 meets all OSHA safety requirements.

After Sales Service

"Service is the foundation of a business". We believe in this philosophy. That is what we have proved to our many customers in this line through numerous installations/commissionings and after-sales-services provided by us to them.

References

Satisfied Indian users of such Hollis machines are : AB Controls, Eastern Peripherals, HAL Hyderabad, HAL Lucknow, IDM, Jenson & Nicholson.

Tell us your PCB assembly requirement and throughput desired. We will promptly submit our proposal to you.

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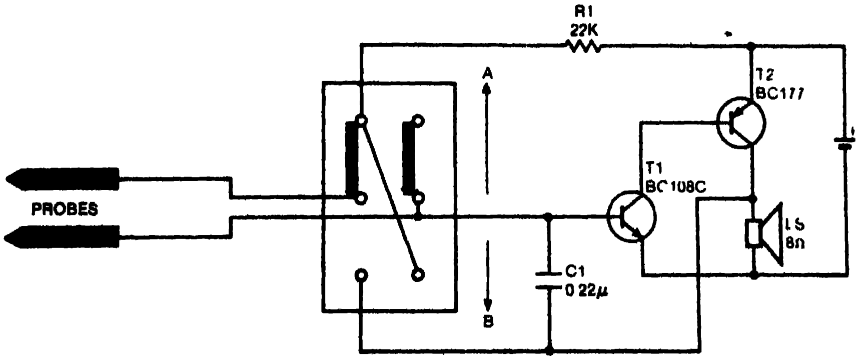
KAVERI

Versatile Tester Simplified

With reference to the construction article by Mr D Venkatasubbiah, published in the January issue, I would like to suggest a small modification Even though the circuit is simple, the provision of four test probes will cause inconvenience Moreover, for capacitance testing, shorting of two probes is also necessary



POSITION A CONTINUITY TESTER
POSITION B CAPACITANCE TESTER

By incorporating a mini DPDT switch, as given in the diagram above, all these tests can be carried out with just two test probes The circuit is self-explanatory When the switch is thrown to one position, it will work as a continuity tester, and in the other position it will work as a capacitance tester

M RAMACHANDRAN
Cochin

The author, Mr D. Venkatasubbiah, replies: The modification suggested by Mr Ramachandran to my article 'Versatile Tester with Audio Indication' is quite valid I thank him and agree with him that the simplification of four probes into two probes is quite convenient and useful with the addition of a DPDT switch

With common probes, the only point to be remembered is that the polarity of probes gets reversed in positions A and B In position A, the upper probe is positive and the lower probe negative In position B, the upper probe becomes negative while the lower one becomes positive If this sign change is taken care of while testing, there is no problem

Learn to Use Microprocessor

I am an electronics hobbyist and a regular reader of Electronics For You since last five years I have read your 'Learn to Use Microprocessor' serial with keen interest and also the articles on add-on boards of 6502, 6809 and 8088 CPU

Now that the age of home computers is coming, why not publish a serial, 'Make Your Own Home Computer' in which an 8k (or 16k) memory may be used with memory expansion facility up to 64k, ASCII type keyboards, and interfaces for TV, printers and cassette player.

It should incorporate BASIC, COBOL and/or PASCAL. As it is difficult to program at the machine code level, programming languages should be used in this kit and there should be provision for future expansion for interface to floppy disc, sound generator speech synthesiser etc

Please recommend some books on computers so that I may make a working computer with the above features

A C DUBEY
Pali-Marwah

The author, Mr K. Padmanabhan, replies: Glad to receive your crisp facts-of-the-case letter

Books on computers only tell you how a microprocessor or computer works, not how it is made

The essence of the computer is its *software* When you want high level languages (HLL), the same are to be either written on your own or bought from software manufacturers

Unfortunately, software is not sold in single quantities It is sold only to manufacturers of computers and is exorbitantly priced because of the time and effort it takes to write it When a computer manufacturer sells several thousands of computers, that price is shared by each piece sold and comes to a reasonable amount

In India, computer manufacturers do the same It is easy to ask for BASIC, COBOL, PASCAL, FORTH just like the villager who wanted his son to know English, French, German, Russian (but his national language is the foundation and backbone, and so is the machine language of a micro) It takes time and effort to write, or rather 'manufacture' that software and is therefore expensive

No book gives the 'software' for any of these high level languages for any microprocessor whatever

In the series of articles on 8085, Z80 the method of using these devices and writing one's own software has been amply brought out in a concise and simple way, with examples If the software for any HLL were available, it could be put in the add-on memory board, and each one of these boards (8085, Z80) would become a microcomputer with HLL

We have to either purchase the software from companies abroad such as Microsoft Corporation, USA or write our own. Even IBM has purchased software from this source! When you want more HLL, the answer is the same We have to purchase from sources which have developed them This becomes expensive

My articles are directed towards simple and inexpensive projects which provide a good deal of learning-by-doing on the subject, aimed at the average electronics student

Let me inform you that a two-part article on making a BASIC HLL microcomputer at home is getting ready and will be mailed to EFY soon It will be simple to construct but very powerful, much like the home computers in the market It will not use a floppy drive or colour graphics(!) but will use a cassette recorder and work on a B&W TV It is based on 6502 The total cost would come to Rs 2500 only

Well this is all we can have now for this money If EFY readers could afford sums of over Rs 15 000 then even an IBM PC compatible computer project would be possible

Suggestions and Comments

I am an electronics student and a regular reader of your magazine The last few issues contain very useful articles on computers The articles on Comparative Study of Computer Languages by Mr R Ramaswamy are so easy that beginners can also understand them

Convey my thanks to Mr R Ramaswamy for such needful and simple articles

Please also publish the photographs and addresses of such authors along with their articles

MUKESH JAIN
Indore

☐ I am a regular subscriber of Electronics For You' We are getting lot of information through this magazine regarding developments in computers Please convey my thanks to Mr R Ramaswamy for his article 'Comparative Study of Computer Languages This article gives very valuable information on computer languages

INTIZAR HUSSAIN
Shahjahanpur

☐ I am a regular reader of your monthly magazine and annual I found some difficulties while consulting your annual

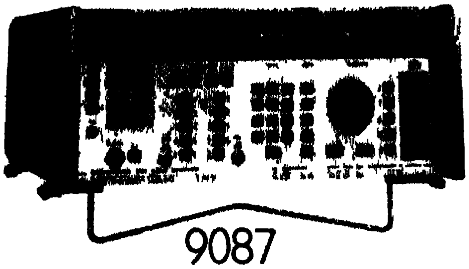
(a) Finding the index page is really difficult in your Annual 1985 This index should be on page 3

(b) Buyer's Guide should also give addresses of the mentioned firms

I have seen a few addresses in your directory which are not existing actually and if existing, they are not manufacturing the product mentioned in your directory And sometimes, there is no correlation between the Buyer's Guide and the Directory sections in the annual

R S KATARIA
New Delhi

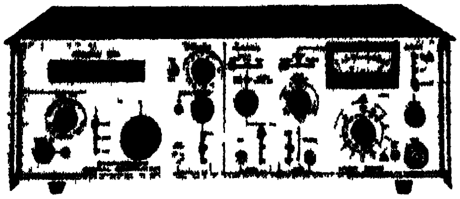
A new dimension in signal generation at your fingertips.



9087

Synthesized Signal Generators

- 10kHz to 1300 MHz, 1 Hz steps
- 159 dB dynamic range, 0.1 dB steps
- - 148 dBc/Hz at 3kHz offset
- 500μSec frequency switching
- ±1dB output accuracy
- Full GPIB



9082

Synthesized Signal Generators

- 1.5MHz to 520MHz
- AM, FM, ØM, Pulse Modulation
- - 130dBm to + 19dBm
- 3 x 10^{-10} per day stability
- Passive doubler to 1040MHz

9084

Synthesized Signal Generators

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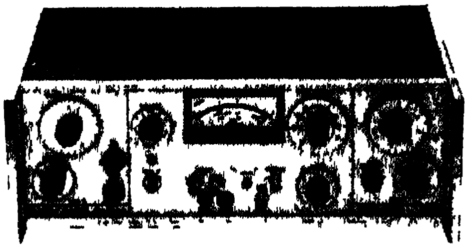
- Non-volatile Memory (96) slots
- Very Low RFI
- High Spectral purity



9083

Twotone Generator

- 10Hz to 100kHz
- 10V RMS output
- Balanced and Unbalanced Output
- Two alternative or mixed tones
- Very low distortion 0.04%

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What's New

IN INDIA....

Budget disappoints ELCINA

The Electronic Component Industries Association (ELCINA) is disappointed to find that the central budget for 1986-87 has not taken care of the serious problems faced by the electronic components industry for the past three years.

The association feels that the reduction of duty on electronic components from 160 per cent to 75 per cent in August, 1983 created a number of serious imbalances in the industry. Exercise for redressal of these anomalies has been going on ever since. Although the association had made a detailed study of the subject and the Department of Electronics had reportedly recommended a package for correcting the anomalies, the Finance Ministry has completely ignored the urgency.

It may be recalled that ELCINA was able to convince the government that the electronic components industry should be made excise-free. In implementing this decision last year, however, only 25 components were allowed exemption. A thorough analysis was made to identify the remaining components and parts which need to be given excise waiver and ELCINA was looking to the budget for correcting this anomaly also. ELCINA has expressed the hope that the government will review the industry's plea for immediate relief.

Spurious TV sets flood market

Spurious television manufacturers located in Delhi are causing the exchequer a loss of about Rs 1000 million annually through evasion of excise duty, sales tax and income-tax, besides cheating innocent consumers.

About 100 such manufacturers in Delhi are supplying black-and-white television sets of the buyers' choice. These unlicensed units assemble sets and fix the brand names of well-known companies.

These units, mainly located in the Old Lajpat Rai Market, Daryaganj, Ansari Road, Bhagirath Place, Kirti Nagar and Krishna Nagar are manufacturing about [illegible] sets daily in and outside Delhi.

According to [illegible] vision set attracts Rs 400 in excise duty and another Rs 400 as sales tax. These unregistered and unlicensed units pay no taxes.

Rules on phone use relaxed

Telephone subscribers can now freely use, without licence, certain approved attachments as the Department of Telecommunications relaxed some conditions recently.

These include: automatic answering and recording devices, pushbutton and dial type telephones, loudspeaking telephones with or without the use of handset, and STD barring devices.

The number of storage devices, auto-dialling devices (subject to the restriction that the number of automatic repeat attempts is not more than one) and devices providing information on call-duration, calling time and called number for use on PABX extensions, also do not need licences.

However, use of cordless telephone will be permitted only under a licence. No testing fee would be levied in individual cases of attachment of imported devices.

Indigenously-manufactured attachments including pushbutton and dial-type telephone would continue to be type-approved by the department and would be sold to subscribers directly by the manufacturers.

TV boom on the wane

If the production and sale figures of TV sets in 1985 are any indication, then the TV boom after the unprecedented growth up to January 1985 in the wake of expansion of the TV transmission network, seems to be on the wane.

The fall in the demand for black-and-white TV sets, particularly that of 51cm screen size, has already adversely affected the indigenous components industry. The manufacturers of black-and-white picture tubes have cut production by 50 per cent since November last year. Even the Electronics Trade and Technology Development Corporation (ET&T), which imports picture tubes on behalf of TV manufacturers, has not ordered fresh imports for quite some time.

Though the actual production figures for 1985 are hard to come by, there are [illegible] indications that the demand projections made by the Indian Television Manufacturers' Association (ITMA) have gone awry.

Telex on demand

Telex services in the country's major cities would be available on demand in the very near future, according to minister of state for Communication, Mr Ram Niwas Mirdha, who was speaking at a consumer business forum recently.

Top priority is to be given in the Seventh Plan to strengthening and modernising the telephone network and to making telex and telegraph services fast, dependable and trouble-free.

Another corporation would be set up for the country's overseas services. This would be in addition to the corporations for Delhi and Bombay telephones. In future no extra charge would be levied for attachments to telephone instruments if they were not compatible with the system.

AREA (E. Zone) president

Mr S.P. Kapur, proprietor of Esperad Electronics has been re-elected as the president of the All India Radio & Electronics Association, E Zone (AREA, E. Zone) for the term 1986-87.

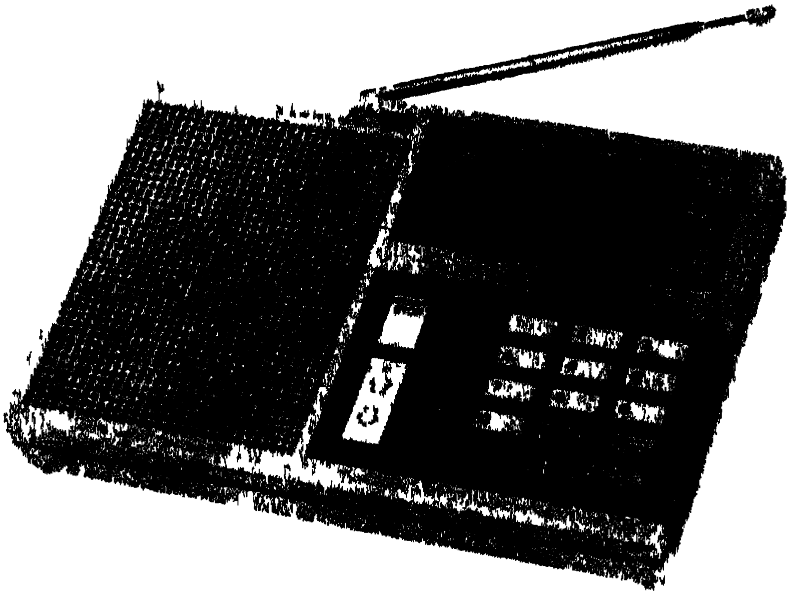
Mr Kapur has served with credit, the AREA (E Zone), as the honorary secretary for five terms from 1979-80 to 1983-84 and is a popular figure in the electronics trade and industry. He has also been an office bearer for several government sponsored seminars, workshops and exhibitions on behalf of the AREA (E Zone).

....AND ABROAD

NDXE Global Radio

A new worldwide high frequency (HF) stereo radio station, NDXE Global Radio, will soon be launched at Opelika city in the USA to reach listeners from Australia to Zaire.

NDXE (pronounced 'in dixie') has been several years in the making. Mr H.D. Norman Jr, who started as a radio station record librarian at the age of eight, conceived the idea with his mentor, late John Herbert Orr, who produced



Tuning in NDXE Global Radio on today s high-tech radios will be as easy as dialling a phone

the first US-manufactured magnetic recording tape and the Orrox CMX video editor

As the world s first privately owned HF stereo station NDXE will offer programming that is totally different from the Voice of America BBC Radio Moscow and other government-run shortwave stations Instead of political rhetoric NDXE s programs will feature live concerts and sporting events worldwide phone in shows, news international weather and music by the world s most popular recording artists

Although HF transmissions have not been considered a viable medium for broadcasting concert hall quality music NDXE s superpower 100kW stereo shortwave transmitter and 100-foot rotatable log periodic antenna will deliver over three million watts of power Broadcasts will be beamed to Europe the Pacific and the Americas In addition to its exciting sound NDXE will be one of the few worldwide HF stations that accepts paid advertising

Europe's fastest growing IC supplier

Plessey Semiconductors is emerging as the fastest growing supplier of integrated circuits in Europe according to an independent survey

Last year the company sold nearly 30 million chips, an increase of almost 29 per cent on the previous year Seventy-[illegible] of the chips were exported with [illegible]nited States mainland E[illegible] the Far East being the larg[illegible]

Plessey Semiconductors is Britain s largest indigenous producer of integrated circuits Its technology enables it to produce chips less than 2mm which can control the motor speed of a housewife s food mixer or carry the switching capability of a ten-thousand-subscriber telephone exchange

The company is managing to cram ever-increasing numbers of electronic components on to a single chip – a development known as very large scale integration (VLSI) This has made possible big reductions in the size and cost of many items of commercial equipment especially data processing devices and telephone systems While producing essential high volumes of general purpose ICs, Plessey Semiconductors also makes relatively small quantities of unique chips for particular customers using computer-aided design methods and by freezing the production process before final interconnections are made

SPOT satellite launched

An earth observation satellite SPOT was recently launched from Kourou in French Guiana and placed in orbit

Conceived and designed by the French Centre National d'Etudes Spatiales (CNES), the SPOT system has been built by the French Industry in association with Belgian and Swedish partners It consists essentially of an earth observation satellite and earth stations for data reception It is by far the most efficient remote sensing system (for non-military use) in the world

SPOT produces 60km wide scenes with high quality land resolution 10 m in panchromatic mode (black-and-white) and 20 m in multispectral mode (colour) It can also deliver observations of a single zone in a minimum of 60 hours

Scientists expect great things from this technological marvel which flies in a heliosynchronous orbit at 6 km per second and goes round the earth in 100 minutes more than 14 times a day On the ground various means have been activated to receive and process the enormous amounts of information and data provided by the SPOT system

In the first phase of the SPOT system there will be two main receiving stations, the first in Toulouse and the second in Estrange (near Kuruna, Sweden) Both will receive direct data from other parts of the world which will have been stored by two on-board recorders The French and Swedish stations can receive some 250 000 pictures a year In addition to these three other receiving stations are ready to receive pictures from SPOT two in Canada and the third in Bangladesh India, China Australia and Saudi Arabia have shown a keen interest in acquiring and processing the remote sensing data SPOT for their own earth stations

Among the main applications for the images sent by the first SPOT mission are land use studies, assessment of renewable resources (agriculture forestry) aid to exploration of mineral and oil resources cartographic work at medium scales analyses of natural catastrophes (flood, drought plant diseases), and mapping and study of routes

A 'hearing' typewriter

A word processor you can speak into rather than having to type into is being developed as part of a £14-million project on speech recognition in Britain The research, which is expected to be completed by 1989, could lead to a range of devices being able to use normal speech as the input It is being conducted by a consortium consisting of the electronics company Plessey, together with Edinburgh and Loughborough Universities and London's Imperial College

The aim is to develop a system that will respond to normal connected speech rather than single words The processor will have an unlimited vocabulary and will display the words on a screen before printing

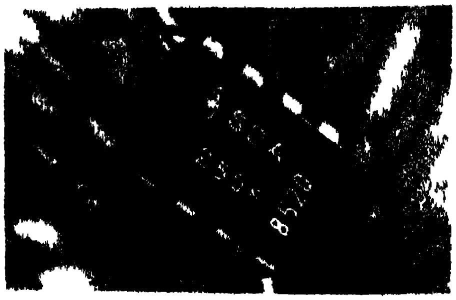
The unit will use a conventional processor to convert speech into electrical impulses Speech analysis will then be carried out by a number of parallel processors These will match words and phrases with the computer s knowledge base to come up with the best matching word The computer will have an initial vocabulary of several thousand words but will have the ability to accept corrections if it gets a word wrong and thereby extend its vocabulary

The aim of the research is to invent a speech processing interface that can be fitted to a range of machines, the word processor being the first The experts anticipate that the speech input proces sor, as it will be called, will cost as much as a desk-top computer

EEPROM with floating gate

With its SDA 2506 non-volatile memory Siemens offers the first model of a generation of EEPROMs (electrically erasable programmable read-only memory) which can be operated from a single 5V supply

Originally designed as a program memory for radio and TV sets the device has now become suitable for all applications where only this single supply is available This encompasses virtually the entire consumer and industrial electronics sectors



This 1024-bit EEPROM works on a single 5V supply

An EEPROM can store important data for over a decade ensuring that not a single bit of information is lost Until now this level of data security was possible only at the added cost of an extra back-up battery on the board Information is stored in the form of a charge on a totally insulated silicon electrode (floating gate) The insulating oxide is traversed by a tunnel junction which connects the floating gate to the semiconductor substrate Siemens has managed to refine an NMOS process for the EEPROM so that the electrons in a charge can pass through this junction with next to no loss—both when storing and deleting information

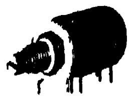
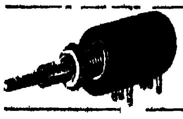
The SDA 2506 is an ideal memory for retaining set values when calibrating equipment Parameters and operating data remain stored even if the supply voltage is switched off intentionally or otherwise Even after many years without power the equipment will still know' what was entered into it originally A back-up battery lasts only a few months

Computex Taipei '86

Computex Taipei, the international computer show held annually in Taiwan, has grown rapidly during its five-year history This year, some 500 top Taiwan suppliers will take part in the show

Computex Taipei 86 will be held from June 2-8 and the morning sessions (9 am to 1 pm) will be open to buyers only Computex '86 will be held at a new venue this year—the Exhibition Hall of the Taipei World Trade Centre

High-quality products will be offerred at competive prices Products on display will be computer systems, microcomputers minicomputers, card readers, magnetic tape devices, magnetic disc devices printers, terminals, monitors, software services and components, local area network, office automation equipment and parts and components

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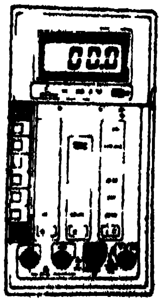

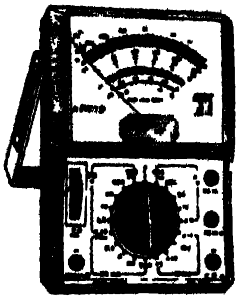

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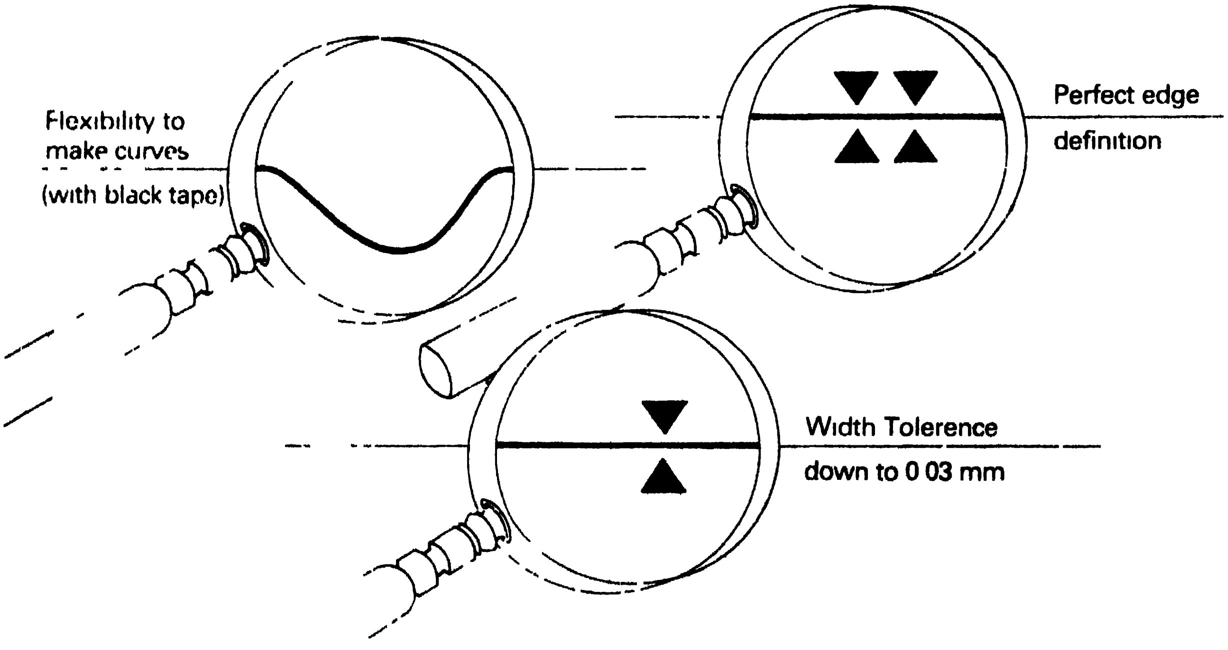
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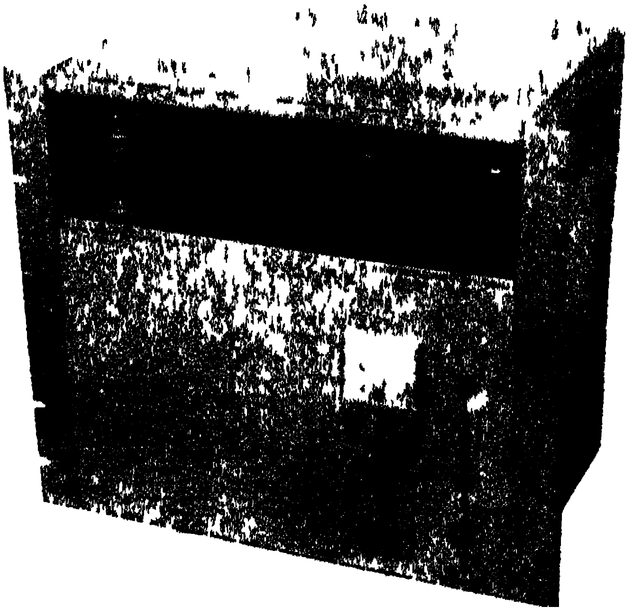

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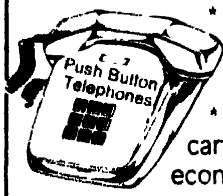

- * Priced nominally higher than the mechanical ones
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- * Convertible to Computer Printer at no cost
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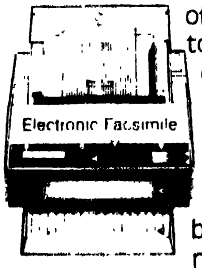
- * Electronic memory writer offers 37K memory to expand efficiency of the Electronic Typewriter



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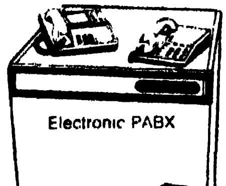

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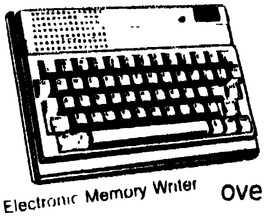

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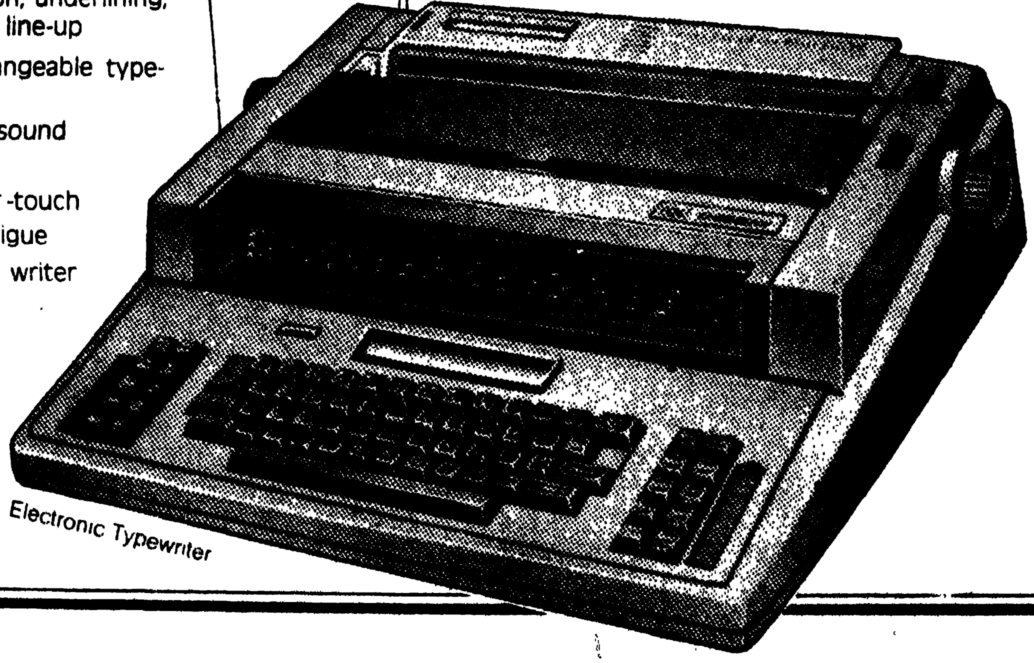

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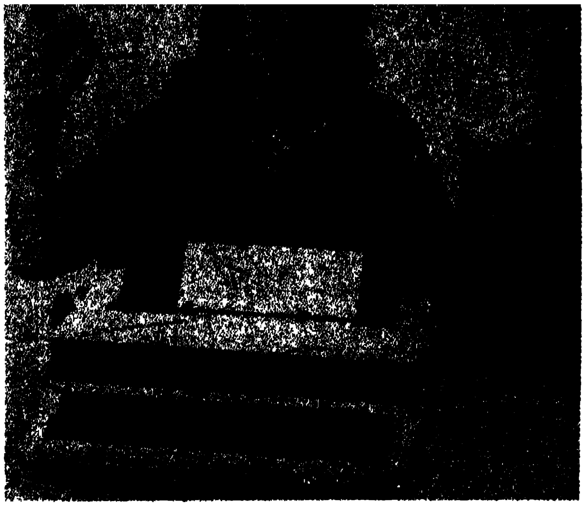


Electronic Typewriters' Guide

Electronic typewriters that were being retailed for 58,000 yens (approx. Rs 2700) in Osaka (Japan) in 1984 still cost over Rs 10,000 in India. And if you require some special features, you may have to spend between Rs 20,000 and Rs 35,000. However, these prices are much lower than one had to pay in 1984 or even during early 1985.

Though most of the cost for an electronic typewriter goes to meet various taxes and duties, as is the case with all office equipment and most electronic goods, there still appears some scope for reduction in prices. With the competition hotting up, and with larger demands and consequent supply, the prices may soon fall further. This in turn would make the purchase of an electronic typewriter more attractive compared with the manual typewriter. It is therefore no wonder that almost all well known mechanical typewriter manufacturing companies have also started manufacturing electronic typewriters.

This does not imply that the mechanical typewriters are going to become obsolete soon. Mechanical typewriters have their own advantages such as economy in operation (electronic typewriter ribbons are much costlier) and non-dependence on electricity (power failures render electronic typewriters useless). Plus they are sturdier (capable of withstanding rough handling) and of course much cheaper at present.

Advantages of electronic typewriters are numerous—depending on the model you choose. They can be used as word processors so that oft-repeated paragraphs, or even full text of letters and forms, can be stored in their memory and recalled (without having to type again) flawlessly, provided you are prepared to spend Rs 35,000. Some publishers are using them as composing machines for subsequent printing by offset process. For this, special features, like justification, centering of text, flush right typing, bold letter printing, and sufficient in-built memory and storage (micro disc) etc are required.

Another popular application of the electronic typewriter is as a daisy-wheel printer for computers. Instead of buying a daisy-wheel printer, many computer users prefer an electronic typewriter as it can also be used independent of the computer. For this, most electronic typewriter suppliers either provide a built-in interface or offer it as an optional item.

A great advantage of all electronic typewriters is that the typefaces can be changed very conveniently within seconds, whereas in the case of a manual typewriter it is almost impossible. Another obvious advantage is the excellence in quality—the matter typed on an electronic typewriter looks almost like printed matter, provided a good quality ribbon is used and the daisy-wheel used is not worn out.

Only a few of the advantages and features have been mentioned here, but in fact there are many more which can be seen in the accompanying buying guide.

Buying guide

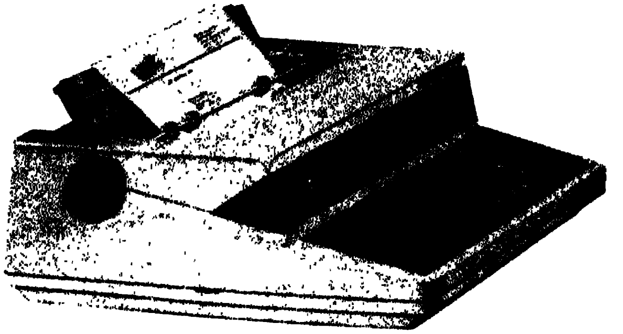
To help EFY readers in doing a preliminary survey of the type of electronic typewriters being offered at present, the buying guide gives the features of some of the available electronic typewriters. Some of the machines could not be included in this guide as the solicited information did not reach us till the time of going to press.

The prices and specifications mentioned here were collected mostly in February and first half of March but they may already have changed in some cases. The buyers are therefore advised to contact the companies for full details and the latest information before placing their orders.

Similarly, though all care has been taken in collecting and publishing the information, EFY cannot take responsibility for any error or mis-interpretation of the information printed here.

Only daisy-wheel type electronic typewriters have been included in the buying guide though one or two companies offer IBM-type typewriters using 'golf-ball' printing elements also.

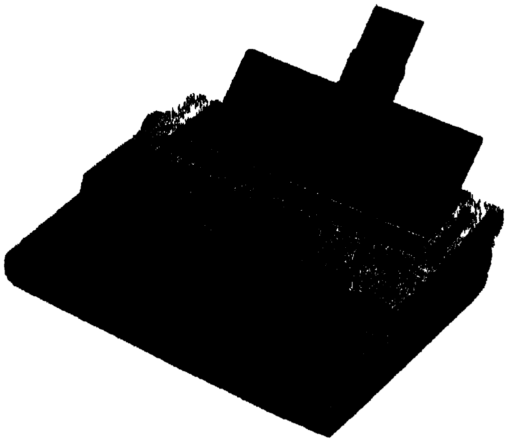
Addresses of most of the well established electronic typewriter suppliers have been published separately so that further details can be obtained from them directly.



DCM TYPESTAR-1

BUYING GUIDE TO ELECTRONIC TYPEWRITERS

Brand	AUTOCON-NAKAJIMA					DCM	FACIT
Company Name	Autocon Control Pvt Ltd					DCM Data Products	Forbes Forbes Campbell & Co.
Model	AE 330	AE 350	AE 375	AE 395	AE 475	TYPESTAR-1	8001
Display	No	No	20-ch. LCD	20-ch. LCD	20-ch. LCD	No	No
Memory	46 strokes correc.	1-line correction 14-day back-up for TAB & MAR	Max. 200 ch or 5 lines correc.	Max. 300 ch or 5 lines correc. 10k Memory	Max. 300 ch. or 5 lines correc. 10k Memory	1-line correction 16-ch. buffer	5-6 lines correc. 3 layouts
Correction Tape	Lift-off	Lift-off		--	-	Lift-off	Lift-off
Interface	Option (built-in) Parallel (Centronics compat.)	Option (built-in) Parallel (Centronics compat.)	Parallel (built-in) (Centronics compat.)	Parallel (built-in) (Centronics compat)	Parallel (built-in) (Centronics compat)	Built-in Centronics parallel	
Printing Speed	13.3 cps max.	13.3 cps max.	15 cps max.	15 cps max.	15 cps max.	12 cps	
Pitch	10, 12, 15 ch/inch	10, 12, 15 ch/inch	10, 12, 15 ch/inch	10, 12, 15, PS	10, 12, 15,PS	10, 12, 15 ch/inch	10, 12, 15, PS
Line Spacing	1, 1½, 2	1, 1½, 2	1, 1½, 2	1, 1½, 2	1, 1½, 2	1, 1½, 2	–
Paper Width	364 mm	364 mm	382 mm	382 mm	420 mm	340 mm	390 mm
Typing Line	292 mm	292 mm	292 mm	292 mm	344 mm	280 mm	330 mm
Keyboard	46 keys	46 keys	46 keys	46 keys	46 keys	—	Very low height
Line Format & Tab Functions	16 positions resettable tab.	20 positions resettable tab. Decimal tabulator	Decimal tabulator Tab centering	Decimal tabulator Tab centering	Decimal tabulator Tab centering	16 positions resettable tab. Decimal tabulator	26 tab stops plus 3 standard settings, Decimal tabulator
Flush Right			Yes	Yes	Yes	No	-
Auto Centering	No	Yes	Yes	Yes	Yes	No	Yes
Auto Underlining	No	Yes	Yes	Yes	Yes	Yes	Yes
Bold Lettering	No	No	--	Yes	Yes	No	Yes
Weight	Approx 9 kg	Approx. 9 kg		--	—	...	18.5 kg
Other Features	Page-end indicator	Auto return Paragraph indent ROM, RAM self-diagnosis Page-end indicator	Auto return Paragraph indent Required hyphen 3-level impression Paper injection lever	Auto return Paper injection lever Paragraph indent Required hyphen Line print, Store Programmable paper insert Justification Text-editing (50 files) Memory functions	Text-editing (50 files) Memory functions Line print, Store Auto return Para indent Paper injection Required hyphen Justification	3-level impression Paper-end indicator Auto return Line-end indicator	Auto return 105-character printwheel Very quiet operation
Optional Accessories	Interface box	Interface box	Auto sheet feeder Serial (RS-232C) kit	Auto sheet feeder Serial (RS 232C) kit	--	—	—
Price (excl. Taxes)	Rs 14,580	Rs 18,450	Rs 21,595	Rs 31,950	Rs 34,200	Rs 16,200	Rs 21,500—2800 discount



USHA SILVER REED EX 200

BUYING GUIDE TO ELECTRONIC TYPEWRITERS

Brand	IRS	HALDA	OLYMPIA	NETWORK			SILVER REED
Company Name	Indian Reprographic Systems Ltd	Methodex Systems Pvt Ltd		Indian Communications Network			Usha Computers & Peripherals Ltd
Model	310	Professional	Super type 2	102 (100 series)	316	332	FX 200
Display	40-ch LCD	No	20-ch fluorescent		20 ch fluorescent	20-ch fluorescent	No
Memory	Ten 255-ch phrase memory 500-ch correction memory 500 hrs storage retention	4000-ch in 18 segments, 500-ch correction memory	16 000-ch in 18 segments 500-ch correction memory	2000-ch 222-ch correction	16,000-ch Word phrase reprint Stored text reprint	32,000-ch Word/phrase search Stored text reprint	32-ch key buffer
Correction Tape	Lift-off		Lift-off/Cover-up	Lift-off	Lift-off	Lift-off	Auto correction
Interface	Optional	Optional	Optional		Optional	Optional	Optional
Printing Speed	13 cps	20 cps	20 cps max	16 cps	20 cps	20 cps	16 cps
Pitch	10, 12, 15	10, 12, 15, PS	10, 12, 15, PS	10, 12 PS, Mini-PS	10 12, 15, PS, Mini-PS	10, 12, 15, PS, Mini-PS	10, 12, 15
Line Spacing	1, 1½, 2 2½			Five types	Five types	Five types	
Paper Width	360 mm	435 mm	435 mm	435 mm	435 mm	435 mm	360 mm
Typing Line	302 mm	358 mm	358 mm	340 mm	340 mm	340 mm	292 mm
Keyboard	46 keys	48 keys	48 keys	46 keys	46 keys	46 keys	46 keys
Line Format & Tab Functions	Decimal tabulator	Decimal tabulator	Decimal and standard tabulator	Decimal tabulator	Auto tab every 5 spaces, special page setting functions	Auto tab every 5 spaces, special page setting functions	Decimal tabulator
Flush Right	Yes		Yes		Yes	Yes	Yes
Auto Centering	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Auto Underlining	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bold Lettering	Yes	Yes	Yes	Yes	Yes	Yes	
Weight	Approx 11 kg	16 5 kg	19 kg	21 kg	20 kg	20 kg	9 kg
Other Features	3-level impact Paragraph indent Page-end indicator Justification Low noise (63 dB) level	Auto return Paragraph indent Expanded print 3-level impact	Auto return Paragraph indent 3-level impact	Vertical lines Auto return Page-end indicator Variable impact	Page-end indicator Auto return Justification Vertical lines Page-end & ribbon-end indicators Text editing	Page-end indicator Auto return Justification Vertical lines Page-end & ribbon-end indicators Text editing	Auto return Paragraph indent
Optional Accessories	Interface for attachment to computer	RS 232C computer interface	RS 232C, Centronics & IEC interfaces, Micro drive for 8k disc tractor feed		RS 232C interface	RS 232C interface	Centronics compatible & RS 232C serial interfaces
Price (excl. Taxes)	Rs 21,915						

CSI TACKER TQ46

BUYING GUIDE TO ELECTRONIC TYPEWRITERS

Brand	**PCL**		**CHALLENGER**		**TACKER**	
Company Name	**Pertech Computers Limited**		**Roneo Vickers India Ltd**		**Communication Services (India) Pvt Ltd**	
Model	FX-253	FX-653	I	II	TQ 42	TQ 46
Display	No	15-ch. LCD	No	40-ch. LCD	No	40-ch. LCD
Memory	1-line correction	8k (16k optional)	10-ch. correction 6-ch. key buffer	1-line (180-ch.) correction 256-ch. key buffer	6-ch. key buffer	1-line (144-ch.) correction 256-ch. key buffer
Correction Tape	-	Lift-off	Lift-off	Lift-off	Lift-off (10-ch.)	--
Interface	Optional	Optional	—	Parallel (Centronics) (RS 232C optional)	—	Parallel (Centronics) (RS 232C optional)
Printing Speed	13 cps	15 cps	12 cps	15 cps	12 cps	15 cps
Pitch	10, 12, 15	10, 12, 15	10, 12	10, 12 or 15	10, 12	10, 12, 15
Line Spacing	1, 1½, 2	1, 1½, 2, 3	1, 1½, 2	1, 1½, 2	1, 1½, 2	1, 1½, 2
Paper Width	343 mm	343 mm	330 mm	330 mm	330 mm	364 mm
Typing Line	280 mm	280 mm	280 mm	305 mm	280 mm	305 mm
Keyboard	46 keys with Math & Scientific	International keyboard plus Math & Scientific	44 keys	44 keys	44 keys	44 keys
Line Format & Tab Functions	Decimal tabulator	Decimal tabulator	13 resettable tab positions	Decimal tabulator 20 resettable tab. positions	13-position tab.	20-position tab.
Flush Right	-	Yes	No	Yes	No	--
Auto Centering		Yes	No	Yes	No	Yes
Auto Underlining		Yes	Yes	Yes	Yes	Yes
Bold Lettering	No	No	No	No	No	No
Weight	7.8 kg	8.6 kg	9.3 kg	10 kg	8.6 kg	12 kg
Other Features	Super/sub script	Paragraph indent Justification Auto return 4-level impact Vertical lines	—	3-level impact Justification	Auto return Paragraph indent	Auto return 3-level impact Justification
Optional Accessories	IF-50 interface Lid cover	Microdisc drive	—	RS 232C interface	—	—
Price (excl. Taxes)			Rs 12,000	Rs 16,500		

Looking for an electronic typewriter?

whether you buy
SEARS OF U.S.A.
or
TRIUMPH ADLER OF WEST GERMANY
or
SMITH CORONA OF U.K.
or
AUTOCON-NAKAJIMA OF INDIA

You buy the same, latest 1986, most proven Japanese technology.

Come to us. We'll show it to you.

Indian Airlines, Bharat Earth Movers Ltd, ET & T Corporation, Centre for Development of Telematics, IIT and many other organisations did not import the latest electronic typewriters from USA, UK, or Germany They came to us and decided on Autocon-Nakajima

Nakajima All of Japan – with whom Auto Controls have a technical co-operation tie-up – are the world's largest manufacturers of electronic typewriters with a monthly production of 50,000 machines Yes, 50,000 a month You've read it correctly

Thoughtful Functional Features

- 100 character daisy wheels
- 5 line correction memory
- Tab Centre and Bold Printing
- Automatic stencil cutting
- Lowest recurring ribbon cost Facility for refilling of cassettes with pancakes
- Simple to operate
- Computer Printer
- Unlimited memory with Word Processing facility

Only ACN offers you the widest range to choose from

Take the Autocon-Nakajima that meets your needs the best

AE 330	Basic Model
AE 350	Advanced Basic Model
AE 375	20 character LCD display
AE 385	8 K memory
AE 395	20 character LCD display and 10 K memory
AE 475	17" Carriage for double foolscap statements LCD display and 10 K memory

ACN

AUTOCON-NAKAJIMA
Electronic Typewriter

The Electronic Typewriter approved by ERTL (N) Department of Electronics, Govt. of India.

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Telex. 11-5972

105 Udyan Darshan,
Sayani Road Prabhadevi
Bombay-400025

CALCUTTA
20-B, Shantiniketan,
8 Camac Street,
Calcutta 700017
Phone 434314

BANGALORE
201, Cama Meenakshi Apartments
4/1 2-3, Plain Street Infantry Road
Bangalore-560001
Phone 577041

CHANDIGARH
1108 Sector 33-C
Chandigarh
Phone 31285

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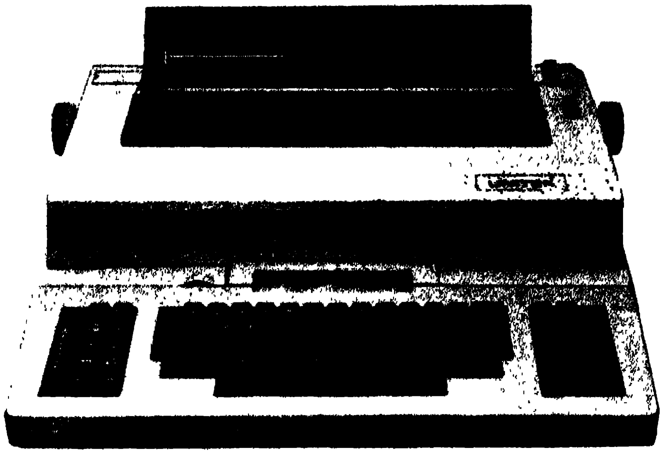

UNITEK EM-2

BUYING GUIDE TO ELECTRONIC TYPEWRITERS

Brand	DEBIKAY		UNITEK			
Company Name	DEI Ltd		Unitek Copiers Pvt Ltd			
Model	EXEC I	EXEC II	EM	EM-1	EM-2	EM-3
Display	No	40-ch. LCD	No	No	40-ch. LCD	20-ch. LCD
Memory	No	1 line (max. 180 ch.)	10-ch. buffer	46-ch. correction 11-ch. buffer	1-line (144 ch.) correction	8k back-up 8k auxiliary optional 2-line auto correction
Correction Tape	Lift-off	Lift-off	Lift-off	Lift-off/Cover-up	Lift-off	Lift-off/Cover-up
Interface	No	Built-in parallel (Centronics compat.)	--	—	Parallel Centronics RS 232C optional	
Printing Speed	15 cps	15 cps	12 cps	15 cps	15 cps	20 cps (bi-dir.)
Pitch	10, 12, 15	10, 12, 15	10, 12	10, 12, 15	10, 12, 15	10, 12, 15, PS
Line Spacing	1, 1½, 2, 3	1, 1½, 2, 3	1, 1½, 2	Variable	1, 1½, 2	1, 1½, 2, 2½
Paper Width	340 mm	340 mm	340 mm	364 mm	364 mm	432 mm
Typing Line	305 mm	305 mm	280 mm	292 mm	305 mm	335 mm
Keyboard	44 keys	44 keys	44 keys	46 keys	44 keys	46 keys
Line Format & Tab Functions		20 resettable tab.		16-position tab.	20-position tab.	Decimal & vertical tabulation
Flush Right	No	Yes	No	–	-	Yes
Auto Centering	No	Yes	No	--	Yes	Yes
Auto Underlining	Yes	Yes	Yes	—	Yes	Yes
Bold Lettering	No	No	No	No	No	Yes
Weight		10 kg	9.3 kg	9 kg	—	16 kg
Other Features	3-level impact Super/sub script	3-level impact Super/sub script Auto return Semi word processing features Justification Vertical lines	—	2nd keyboard Adjustable impact	3-level impact 2nd keyboard for special signs & symbols	Auto return Paragraph indent Mail merge Text editing Key word/line search Super/sub script Help key
Optional Accessories		—			RS 232C interface	—
Price (excl. Taxes)		Rs 18,500	Rs 14,000		Rs 18,500	Rs 30,500

Addresses of some Prominent Manufacturers of Electronic Typewriters

ADVANI-OERLIKON LTD

Regd Off
Ador House
6K Dubash Marg
Bombay 400023
(Ph: 242525; Gm. CITRONEX, Tlx: 011 2781 ADOR IN)

ALTOS INDIA LTD

A-79 DDA Sheds
Okhla Industrial Area, Phase II
New Delhi 110020
(Ph: 634376; Tlx: 031-4668 RRND IN)

AUTO CONTROLS PRIVATE LIMITED

414 New Delhi House
27 Barakhamba Road
New Delhi 110001
(Ph: 3316464, 3310137; Gm. AUCOPRYL, Tlx ND 4048)

B-12 New Delhi House
27 Barakhamba Road
New Delhi 110001
(Ph 3316464, 3310137)

105 Udyan Darshan
Sayani Road, Prabhadevi
Bombay 400025
(Ph 594753)

20B Shantiniketan
8 Camac Street
Calcutta 700017
(Ph: 434314)

201 Cama Meenakshi Apartments
4/1 2-3 Plain Street Infantry Road
Bangalore 560001
(Ph: 577041)

1108, Sector 33-C
Chandigarh
(Ph: 31285)

COMMUNICATION SERVICES (INDIA) PVT LTD

B-26 Sagar Apartments
6 Tilak Marg
New Delhi 110001
(Ph: 383322, 381772; Gm: ELETYPE)

COPY-MAX PVT LTD

911 Padma Tower
5 Rajendra Place
New Delhi 110008
(Ph: 5719589, 5728598)

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A-Block, Shivalaya Building
Commander-in-Chief Road
Madras

Vishwa Sadan
Near Ashiana Building
Exhibition Road
Patna
(Ph. 22720)

Branch Offs
36/816, PSK Building
Chittoor Road
Ernakulam
Cochin

81/62 Hazrat Ganj, Prince Complex
Behind Sahu Cinema
Lucknow

6 Divya Vasundara
Commerce House
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Mirzapur Road
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New Delhi 110008
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Tulsiani Chambers
Nariman Point
Bombay 400021
(Ph 224239, Gm DECEMDATA, Tlx 011-2320)

Shantiniketan, 3rd Floor
8 Camac Street
Calcutta 700017
(Ph. 443538, 433947; Gm DECEMDATA, Tlx 021 2840)

Meco House, 2nd Floor
47 Mount Road
Madras 600020
(Ph. 849520, 849571, Gm DECEMDATA, Tlx 041 7272)

2nd Floor, 8E Rani Jhansi Road
New Delhi 110055
(Ph. 520455, 522128, 520847, Gm COMPUTER)

4th Floor, H.K. House
Ashram Road
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(Ph: 446187; Gm- DECEMDATA)

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Pune 411001
(Ph. 61618; Gm. DECEMDATA)

Punjab National Bank Bldg
Bank Square, Sector 17
Chandigarh 160017
(Ph. 29314; Gm: DECEMDATA)

Ambily Building
XXXV/1092C Warriam Road
Ernakulam
Cochin 682016
(Ph. 35087; Gm. DECEMDATA)

1st Floor, Ashok Garden
160 Sardar Patel Road
Secunderabad 500003
(Ph. 822596; Gm. DECEMDATA)

1st Floor, Doraiswamy Bldg
No. 1 Taluk Office Road
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European Electronics Market: ELCINA's Viewpoint

During the past few years, there has been a renewed emphasis on growth of the electronics industry in India. The Department of Electronics (DoE) has prepared the Seventh Plan for the industry, covering 1985-90, envisaging over five-fold growth in production as well as exports.

The electronic components industry is expected to achieve a seven-fold increase in the next five years—a stupendous task indeed. Estimates of additional investments required in this area alone range between Rs 4000 and 5000 million.

The executive committee of ELCINA, aware of the additional responsibilities to meet the new challenge of seven-fold increase in production expected from the components sector in a span of five years, decided to sponsor a delegation of its members to visit some important centres in Europe.

The ELCINA delegation consisted of 18 members experienced in their respective fields of operation, led by the association president, Mr J.S. Monga. Other members included Mr R. Venkatraman, immediate past-president, two vice-presidents, Mr S.P. Kotwal and Mr D.V.S. Raju, Mr R.S. Buttoo, joint director, DoE, Mr G.S. Rao, electronics advisor in the Indian mission to the European Economic Community Trade Centre in Belgium, and ELCINA's secretary-general, Mr Ghanisham Dass.

The itinerary covered Frankfurt, Paris, Brussels, Amsterdam, Munich and London from November 2 to 19, 1985.

The general observations made by the delegation, based on which ELCINA has framed some recommendations for consideration of the government and the industry, are given here.

Observations

It is essential to analyse and evaluate the scenario in the electronics industry since changes are taken for granted. With this in view, ELCINA has made it a practice to observe the changing and emerging trends, current practices etc after each delegation, and see if these can be profitably employed in the Indian industry for the benefit of the country.

The important points that emerged on this trip can be summarised as follows:

The French electronics industry is at cross-roads. The boom in the growth of telecommunication sector seems to have petered out, and reorganisation as well as rethinking is taking place in the French circles to identify their future role in the world scene. While at the higher levels of business and the government an interest in the Indian industry is certainly visible, this has not percolated down to the medium scale enterprises as is evident from their slow response to Indian overtures.

France has put strong emphasis on the indigenous components industry and has been able to more or less balance its export-import trade. The components sector, particularly that of ICs, is growing fast.

For France, India is a relatively new market place which was opened up by the entry of CIT-Alcatel in India. The French component manufacturers are yet to appreciate the possibilities. With properly planned efforts, it should be possible to convince them that their participation in the development activities in India will not only be beneficial, but is also essential for their long-term growth objectives.

In Belgium, efforts are being made to improve their competitiveness and growth rate.

Philips, being the one large company dominating Holland, seems determined to grow aggressively. In fact, Philips

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This is a summary of the general observations and recommendations made by an 18-member delegation led by ELCINA's president, Mr J.S. Monga, which visited several European countries in November last.

seems to be the only company in Europe where a conscious effort seems to have been made to compete with the Japanese in all their strong areas.

West Germany has been in the forefront of technological changes in Europe and seems to continue this trend. For example, considerable attention is being paid to the SMD technology, and the Munich Fair displayed both the European interest in this area as well as visible Japanese dominance.

But the Germans seem to be preoccupied with the US market, and there is little enthusiasm visible towards India. However, their DEG (an organisation which encourages private investment in developing countries) has interesting schemes. They are also training Chinese engineers in Germany, as part of their promotional effort. This could be worth pursuing by India for similar programmes.

Industrial leaders in the field of electronic components in the UK seem to be very enthusiastic about India - not so much as a market for finished goods but as a possible base for manufacture. This was in marked contrast to the impressions gathered by Indians during discussions with visiting industrialists from the component sector in the recent past. Apparently, the recent changes in the environment in India have helped. All efforts must be made to make full use of this changed attitude.

The meeting with EEC (European Economic Community) mission revealed the overall perception of the European industry as an obsession and fear of the Japanese dominance. Concerted efforts are being made to bring the EEC countries together to achieve viable volumes and alternatives. Programmes like ESPIRIT and EUREKA are being implemented to achieve this. Within EEC there is a school of thought that favours increased attention to India in order to improve their own marketing strengths.

Recommendations

After carefully considering the various observations made by its delegation, ELCINA, in agreement with the same, makes the following recommendations for consideration of the government and the industry:

1. There is a strong possibility of increased cooperation with Europe to improve our technology base. It is possible that eventually, India will have a better bargaining position with the Europeans in view of their current situation, and better prospects of export compared to the USA or the Far East.

2. The available support from EEC and individual countries could be utilised to improve our own technology base by persuading these countries to accept Indian engineers for training in the universities and industry under various scholarships in identified areas of our technological weakness. This would provide a low-cost solution to acquiring technology.

3. It is feasible to persuade the European industry to find partners in India and transfer otherwise uncompetitive production lines to India for exporting back to Europe.

4. The capital equipment and materials is a weak area in India. It is possible to plan and work out suitable cooperation with EEC specifically to found institutes with a clear goal of achieving maximum production within India. When this is achieved, the cost of acquiring knowhow or patent rights could be reduced even to 10 per cent of the present costs, thereby improving competitiveness of the Indian industry. Europe is more amenable to this than Japan or the USA since the quantities are much larger and lines are more automated in case of the latter countries.

5. The systems and methods employed by France to protect its industry from the Japanese competition is worth studying for our own benefit.

6. The French Industries Association disseminates data of production, import and export on a monthly basis. The French government is cooperating in giving this information. Such information base could be used in India for better understanding and analysis of trends.

7. The delegation noted the enthusiasm with which the Indian mission to EEC is pursuing the objectives. It is recommended that this set-up be strengthened in such a way that it becomes the gateway for the thrust to an aggressive export effort to Europe, and in arranging offshore production facilities in India for European manufacturers who would otherwise go out of production because of the Japanese dominance.

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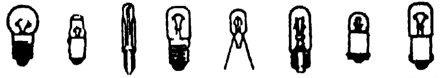

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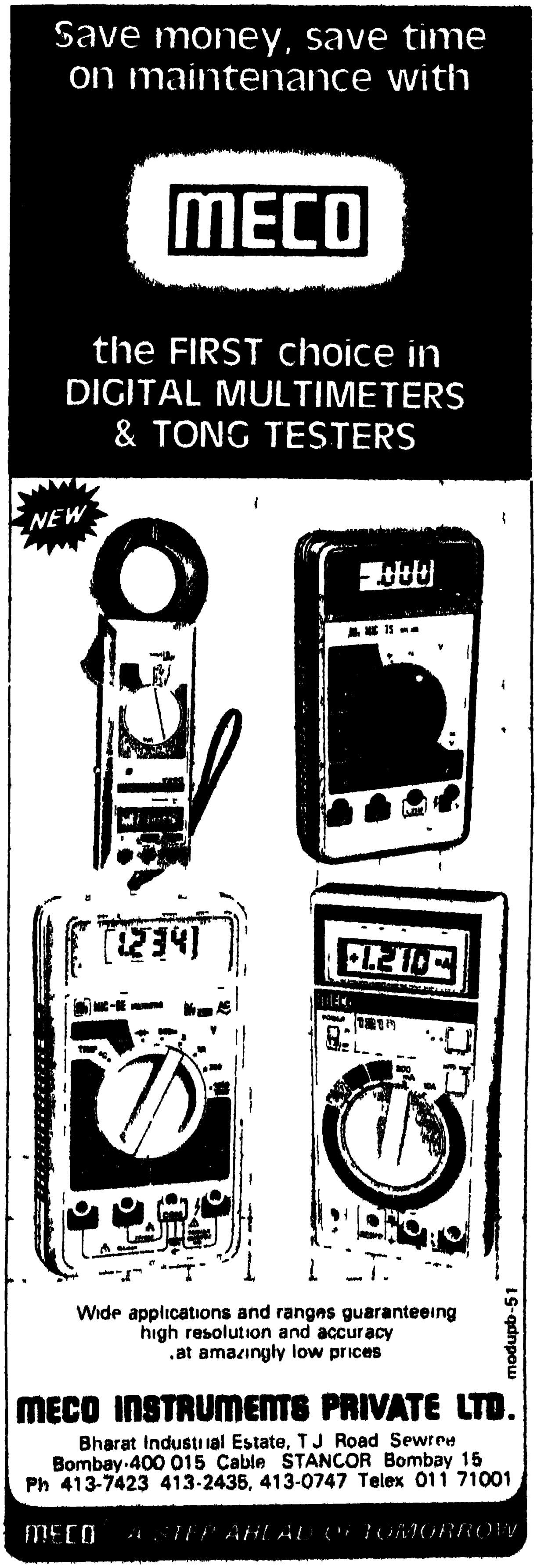

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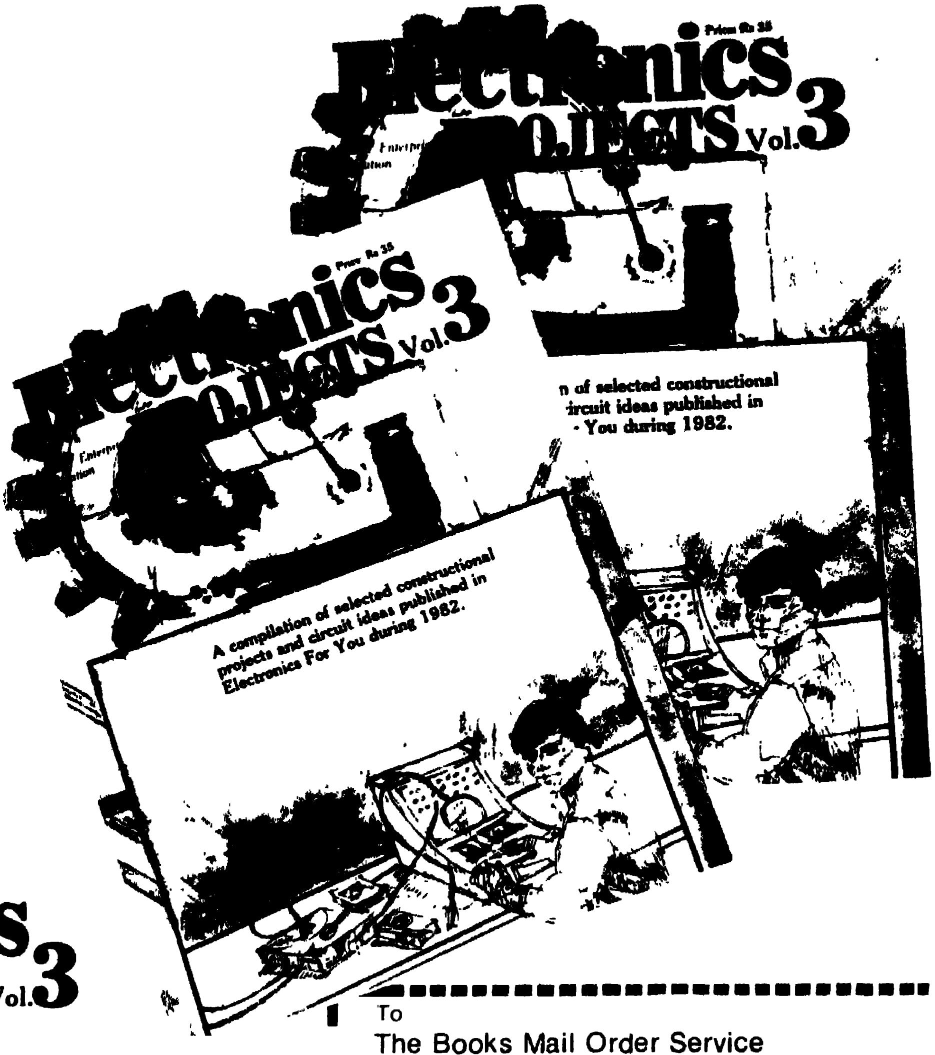
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The Saga of Crystals

Part II

A.V. Jacob

Crystals invariably generate the master clock frequency for computers. All other subsidiary frequencies are then derived from the master clock. For instance, TRS-80 colour computers SAM (synchronous address multiplier) chip, which operates as part of the system clock, develops all the frequencies needed to run the computer. The series-resonant crystal oscillator circuit that runs at 14.31818 MHz is the master oscillator. This is the master clock frequency for the computer. To generate a good colour picture, a frequency of exactly 3.579554 MHz must be produced along with the system. This is accomplished by dividing the master frequency by four. However, the CPU needs two frequencies called E and Q frequencies around 0.89 MHz which are 90° out of phase. For this, the master frequency is divided by 16. SAM chips take care of all these aspects which are entirely based on the master crystal oscillator.

A conventional crystal-controlled oscillator that resonates at 12.288 MHz is used in Heathkit H-89A microcomputer which is then divided by six to produce a clock frequency of 2.0488 MHz before it is applied to the CPU Z80. The near obsolete COP 400 series of microcomputers from National Semiconductors uses the externally synchronised crystal oscillator (Fig. 18). Its 8-bit version, INS 8060 called SC/MP, often makes use of a low-pass filter along with the oscillator. The crystal frequency is limited to 4 MHz and the time interval of a micro cycle is four times the time period of the oscillator.

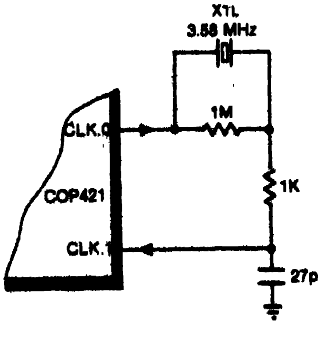


Fig. 18: The COP system clock.

Although 500-nanosecond clock period is standard, many CPUs and clock generators are equipped with dividers in the internal structure. Hence, the clock frequency is fairly higher than the system frequency. For instance, Intel's 8080/9080 CPU makes use of 8224 system clock generator-driver and its XTL1 and XTL2 pins directly absorb the crystal connections. However, the clock frequency cannot be made equal to the crystal frequency since 8224 divides the crystal frequency by nine which means that the usual 500-nanosecond clock requires an 18MHz crystal.

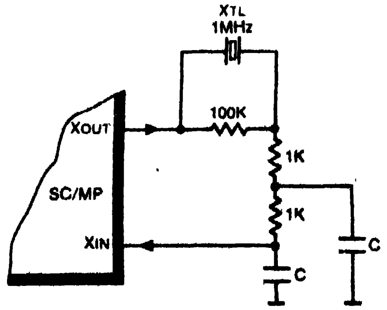


Fig. 19: SC/MP with low frequency XTL and low-pass filter.

On the contrary, since 8085 has its own built-in oscillator section and a divider stage, the clock for the system is half the crystal frequency which is directly available at the CLK pin for any other synchronisation purpose within the microcomputer system. Thus a 6.144MHz crystal provides a system clock of 325 nanoseconds.

This approach is widely appreciated mainly due to the elimination of the clock generator 8224, which requires multiple-step power supplies. Similarly, Motorola's single-chip microcomputers of the MC6800 family are equipped with on-chip clock oscillators often with a divide-by-four circuit. A 4MHz crystal oscillator develops TTL level-processor clock of 1MHz for data synchronisation. Another important aspect of these 4-bit and 8-bit microprocessors is that they operate at a very low system frequency compared with their recent versions of 16-bit MPUs.

A different approach is used for VHF crystals which operate on very high mechanical overtones. In such cases, the overtones both above and below the desired resonance are suppressed using a selective network. The Texas Instruments' TNS microcomputer's clock generator TIM9904 - which is also known in the qualified product list (QPL) of TTL standards as SN74LS362, manufactured by the specifications of low-power schottky technology, hence the 74LS part number—is a representative of these classes of oscillators. An LC tank circuit is used for mode suppression. For instance, TMS9900 microprocessor operating with its standard 3MHz frequency may need a crystal with a resonant frequency of 48 MHz at its third overtone. In Intel's first 16-bit microprocessor—a unique transformation of its earlier products like 8080 and 8085—the clock generator 8284 adopts a similar approach for the tank circuit in the overtone mode as given in Fig. 24.

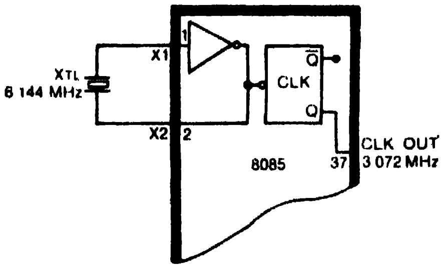


Fig. 20: 8085 system clock.

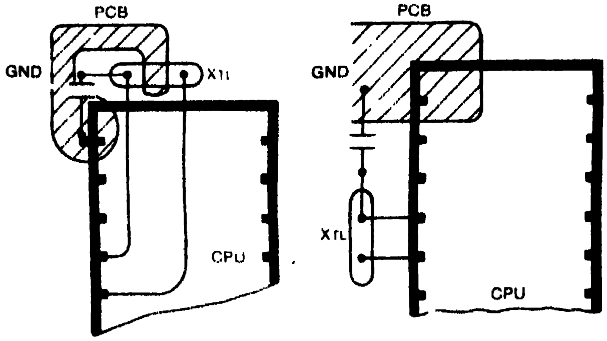


Fig. 21: Two methods to keep XTL leads minimum.

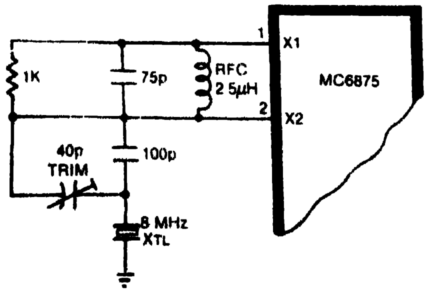


Fig. 22: Motorola's MC6875 clock generator.

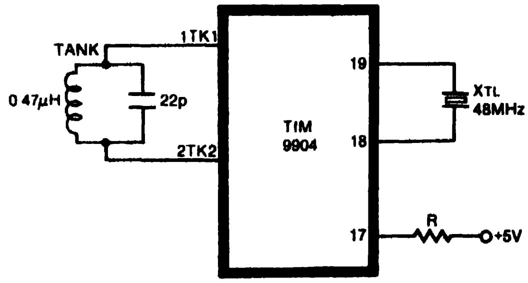


Fig. 23: Third overtone 48 MHz XTL drive for TIM 9904.

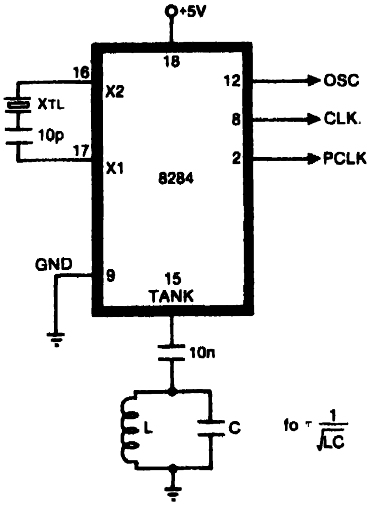


Fig. 24: Overtone XTL clock generator with 8284 for Intel's 8086 CPU.

Growing applications

The number of fields in which the crystal-controlled circuit is providing valuable assistance is continually growing. Purpose-built crystal modules with the facilities for adaptation in a wide range of applications are currently in demand. Temperature compensated crystal oscillator (TCXO), oven control crystal oscillator (OCXO), voltage-controlled crystal oscillator (VCXO), temperature compensated VCXO (TCVCXO), phase locked crystal oscillators (PLXO), digitally compensated crystal oscillator (DCXO) etc are the crystal-based hybrid circuits available in convenient single packages. There is a choice of different modes of crystal oscillators up to 500 MHz and many other options including the power supply range.

The electrical analogue of the quartz crystal assumes the structure of a resonant LCR circuit with a very low value of R. Consequently, the ratio of reactance to resistance or the Q value of the crystal is extremely high. When the frequency of the current through the quartz crystal is varied, the characteristic resonant and anti-resonant frequencies are effectively segregated. The crystal presents low impedance to signals at the series resonance and moderately high impedance at off-resonant frequencies. This is exactly what the radio designers need for the construction of IF transformers which are otherwise constantly plagued by a low value of Q (about 300 to 400 at low frequencies) due to leakage inductance, wire resistance, self capacitance and all other sorts of leakage reactance. Dr J. Robinson, a British scientist, first used quartz crystal resonators in radio receivers in 1929, thus heralding the era of super-selectivity.

A conventional bandpass filter incorporating crystal units is given in Fig. 27. The series resonance frequencies of the crystals are separated by the required bandpass and the balancing trimmer connected across the higher frequency crystal steepens the sides of the selectivity curves. This selector circuit has bandpass characteristics combining almost any desired bandwidth with a flat bandpass, steep slopes beyond cut-off frequencies with high-order rejection of unwanted signals in the attenuation band. The selectivity of the receiver can be further redefined by adding crystal units to the filter section as shown in Fig. 28.

A block filter consists of ten or more crystal elements connected in a cascade half-lattice configuration. This type of filter is usually employed in VHF receivers with frequencies between 9 MHz and 10.7 MHz. It is a single quartz plate on which a number of mechanically-coupled resonators are printed. All elements including capacitors and matching transformers are mounted in a single metal housing. Similar crystal-controlled filters are available for band rejection, equalised delay, discriminators and comb-filters. Some of the well known filters like Butterworth, Chebychev, elliptical, Gaussian and Bessel type are also realised within the fabrics of quartz.

The earliest observations of piezoelectricity led to the introduction of the first man-made device called bimorph by the Curie brothers. To form a bimorph, two bars are cut from X-cut plates on opposite diagonals and cemented together. Depending upon the crystal cuts, the bimorph develops emf across the plates when it is pressed or twisted. Bending the bimorph like a cantilever or applying force at its centre also produces a proportional potential difference

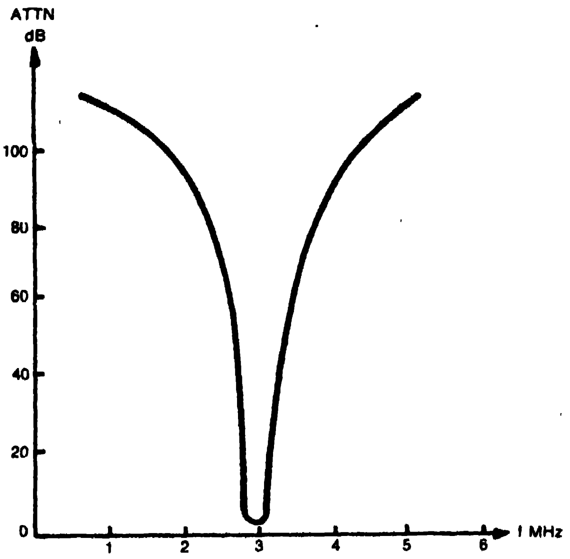


Fig. 25: Attenuation of narrow bandpass XTL filter.

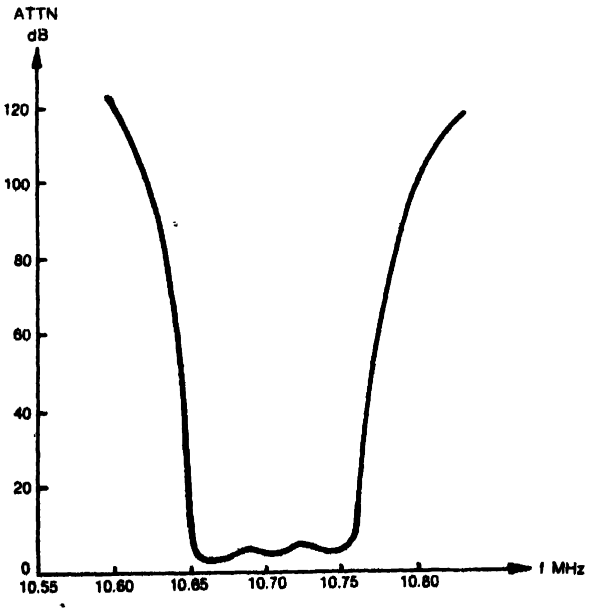


Fig. 26: Attenuation of multielement narrow bandpass XTL filter.

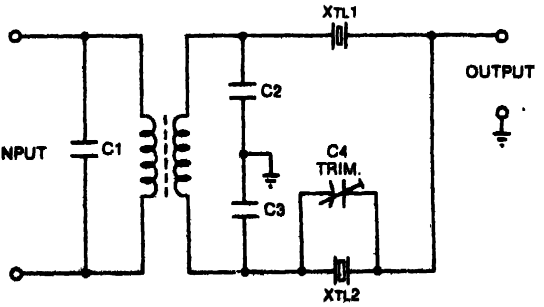


Fig. 27: Half-lattice XTL filter with balancing trimmer for adjacent channel selectivity.

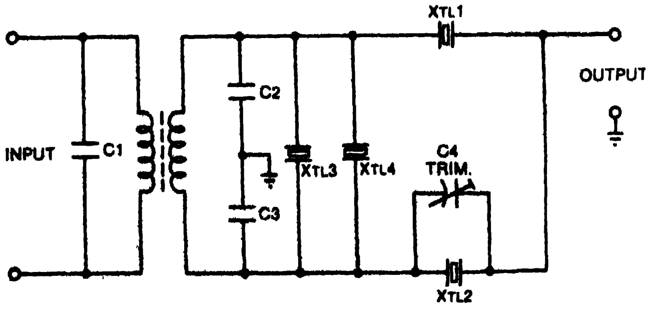


Fig. 28: Half-lattice crystal filter reduce side response using XTL3 and XTL4.

across the metal plates. The opposite effect produces novel features. A potential difference applied to the metal plates causes one bar to contract on one side with an expansion on the other. The net effect is that the bimorph bends to one side. By changing the polarity of the applied potential difference the bimorph bends to the other side. If the polarity of the applied potential difference changes rapidly, a proportional vibration in amplitude can be expected.

Bimorphs were only a humble beginning of a new genre of transducers. The sound pressure wave variation can be used. to bend or press the crystal bimorph by converting one face of the bimorph to a diaphragm. The sensitivity of such a device is increased by stacking a number of bimorphs together, leaving a thin laye of air in between each of them. This is known as the crystal microphone, a high impedance device used for a very short distance operation. There are a host of practical difficulties around this device. First of all, the length of the connecting cable to the amplifier has to be kept at just a few centimeters in order to avoid noise and unusual reduction in the output levels. Secondly, the crystal elements deteriorate rapidly at high temperatures starting from around 45^0 Celsius. Thirdly, since these are high-impedance devices, the input ends have to be carefully selected and matched. Yet, despite these practical difficulties, crystal microphone is the undisputed leader in VOX (voice operated switch) remote control devices.

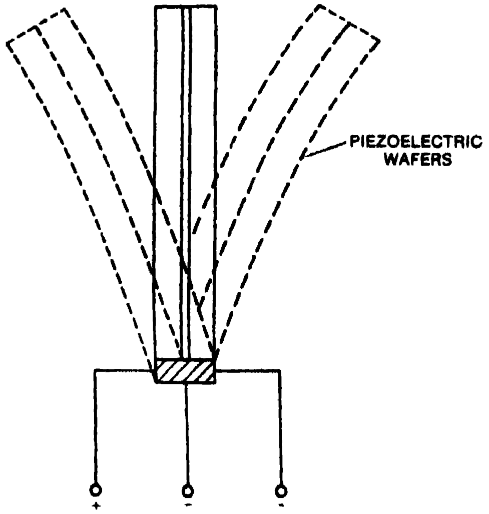


Fig. 29: Piezoelectric bimorph.

Electrical-to-acoustical transducers are also within the crystal's reach. The piezo tweeter horn has a membrane driven by a small plate of piezoceramic material. The impedance offered by this device resembles that of a capacitor. The useful sound levels lie within the upper two octaves of the audio spectrum covering frequencies above 7 kHz. Piezo tweeters have very high efficiency and can be driven by a battery powered circuit. (However, sceptics reject the piezo loudspeaker design for three reasons: crystal impedance is very high; amplitude of oscillation is limited before the margin of fracture of the crystal; and its resonances are too well pronounced to use in octave ranges.) In ultrasonic ranges, especially at the low power region, there is no other choice except piezos.

Piezoelectric relays

Over the past 50 years, a lot of miniature relays have been designed. Most of them suffer from problems such as unwanted noise, heat, spark etc. Furthermore, the majority always has problems with the size of the device. Piezoelectric relays based on the same old bimorph principle seem to be attractive in many ways, especially for the printer type applications. According to the manufacturers, the piezoelectric relay or actuator has a longer life and silent fast switching compared to the conventional electromechanical versions. A piezo relay dot matrix printer operates at a high speed with considerably less heat generation than a solenoid type conventional dot matrix printer. The only problem is centered around the 40-volt actuation potential demanded by the piezoelectric relays.

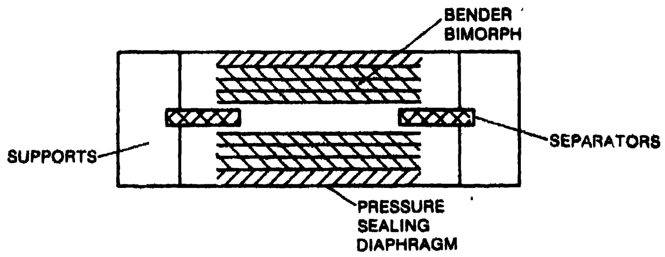


Fig. 30: Construction of the sound cell of crystal microphone.

Piezoelectric effect has systematically found its way to the transducer arena in both active and passive forms. In the active transducers, where the device does not require electrical energy for its operation since it's a self-generating device, the electric properties are made use of. Three most difficult parameters like pressure, force and torque are sensed and calibrated using this technique. In the passive form, where an external electric source is necessary for the operation, piezo-resistive properties are used. Physical parameters like displacement, pressure, force, acceleration and torque are tamed by this approach.

Quartz crystals generate a charge as a result of applied pressure. The strain-induced charge on the quartz crystals is measured using specially designed instruments. These active devices develop not less than 2 mV per psi with appreciable linearity over a wide dynamic range, reproducibility and high-frequency capability. The immediate problem in this type of instrumentation is the need for high-impedance amplifiers for the faithful transfer of information for further processing. With the advent of very high input impedance op-amps, the instrumentation technique looks fairly stable and reliable.

Natural or synthetic quartz wafers are generally useful in the transducers. Quartz is crystallised silicon dioxide. In nature it is formed from molten magma (rock) which crystalises very slowly within the earth's crust giving rise to large crystals. Synthetic quartz, prepared by the hydrothermal process, ensures purity of the crystal which is essential for the manufacture of precision components. A supersaturated solution of quartz is prepared by heating raw quartz in an alkaline solution of water up to 400°C at 100 atm pressure in a sturdy container. A sheet of pure quartz is placed hanging in the solution of superheated water and quartz, to act as a seed for the pure quartz to crystallise on. Quartz crystals of dimensions 50mm by 150mm are obtained in three to four weeks' time. This synthetic quartz has a refractive index between 1.54 to 1.55 and a specific gravity of 2.65, which is very close to that of natural quartz crystals.

Quartz domination in instrumentation as an active transducer is seriously challenged by the passive piezo-junction transducer which is nothing but a p-n junction diode. On this specially designed diode, stress can be applied uniformly over the entire surface of the device or can be applied locally at any point using a blunt element. The former technique is not reliable due to the unpredictable behaviour of the diode on overall distribution of stress. However, the localised stressing technique is found to be extremely rewarding. The band gap of the semiconductor and the concentration of minority carriers show changes in the presence of local stress. Consequently, there is a considerable change in the forward and reverse characteristics of the p-n junction diode.

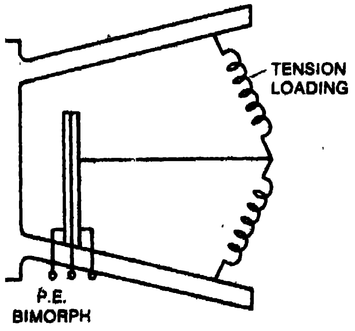


Fig. 31: Schematic of a crystal microphone.

In the year 1965, A. Benjaminson of Hewlett Packard pointed out that the empirical relation existing between the frequency of oscillation of a quartz crystal and its ambient temperature is

$$f(t) = f(o) (1+at+bt^2+ct^3..)$$

where a, b and c are the first, second and third order temperature coefficients respectively. For a highly stable frequency generator, the constant 'a' must be very close to zero. This is often referred to as 'alpha quartz'. The crystals which are used in thermometry are oriented in a mode known as the thickness-shear mode and designated as LC cut. In this orientation, the constants b and c, known as beta and gamma, are made equal to zero and the temperature coefficient to 35.4 ppm per degree Celsius. Thus the degree of sensitivity of the LC-cut crystal is controlled by its resonant frequency. For example, a sensitivity of 1 kHz per degree Celsius is derived by cutting an LC crystal for a resonant frequency of 28.249 MHz, which is not at all a difficult task in terms of the state-of-the-art. The issue becomes simpler if we can be less rigid on the degree of sensitivity. A 100Hz/°C deviation from the centre frequency can be produced by an LC-cut crystal which resonates at the frequency of an 2.825 MHz.

Advantages of quartz temperature sensors

The linearity of the quartz temperature sensors ranges from -50°C to 250°C as opposed to the silicon p-n junction range of -55°C to 125°C. Moreover, quartz oscillators can be readily assimilated in the digital circuits whereas in silicon junction sensors, a high precision analogue-to-digital converter is unavoidable. The absence of intermediate conversion processes effectively minimises the possible error sources to a greater extent. A wide variety of error sources is checked in the fabrication of the sensor itself. Hair-thin quartz wafers are electrically contacted over the surfaces of the crystal by gold-deposited electrodes to minimise the contact resistances and corrosion problems. Crystals are placed in transistor cases such as TO-18, TO-72 or TO-5 to make them immune to mechanical drift and local stress and strain. The wafer is then hermetically sealed in a helium atmosphere for better heat conduction. This also provides a long-term stability due to the presence of inert atmosphere. To avoid self-generated thermal problems, the power dissipation in quartz sensors is limited to a fraction of a microwatt—all of which also has a pronounced effect on the costs.

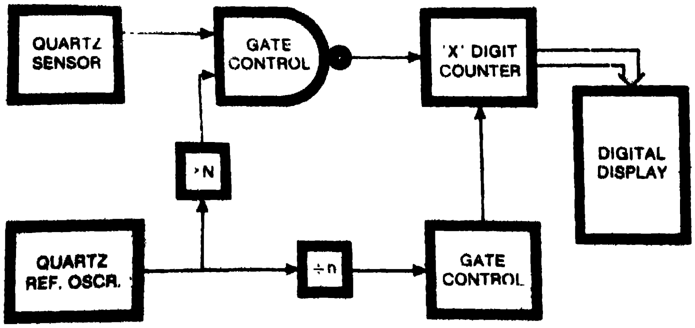
Quartz thermometer circuits make use of hetrodyning principle in extracting the useful information from the resonant frequency. The sensor frequency is mixed with a fixed reference frequency producing a beat frequency which is in direct terms with the actual variations. This is then digitally conditioned for the numerical display so as to detect even milli-Celsius variations. The high frequency characteristic of the sensor is an added advantage in telemetry type applications. The transmitted information is akin to a frequency-modulated system, hence the information recovery is not at all an unusual task. If desired, the sensor output can be sent to distant locations through cables without any serious deterioration in the content. In industrial applications, these properties are really invaluable. Analogue readouts are also possible but are seldom resorted to due to the natural convenience in digitalising the sensed information.

Optical properties of crystals were known much before the 17th century. An optical device for producing plane polarised light was invented in 1828 by William Nicol who was an expert in cutting and polishing gems and crystals. When ordinary light is passed through a tourmaline crystal, the light is polarised and the waves are confined to only one direction, i.e. perpendicular to the direction of propagation of light. In 1669, Erasmus Bartholinus observed a phenomenon called double refraction, in which a ray of light is refracted by a crystal giving rise to two refracted rays of different velocities. This helped in the classification of the minerals too. The value of double refraction is obtained by subtracting the refractive index of the lower ray from the higher one. Due to the relentless work done by Christian Huygens (1629-1695), crystals were again divided in terms of the waveforms of double refraction as positive and negative crystals. Quartz is a positive crystal with a double refraction value of 0.009. But this merely touched the tip of the iceberg and the opticians could only guess at the enormity of the submerged facts.

Integrating optical and piezoelectric approaches

One idea that combines both kinds of approaches, optical and piezoelectric, is now being considered more seriously by the manufacturers. The key feature of a grating array transducer for acoustic surface waves is a material that is both photoconducting and piezoelectric so that light can create conducting regions within the materials. Sections of a block of single crystal CdS are bonded to an aluminium block or lithium niobate ($LiNbO_3$), each half an acoustic wavelength long, and alternately illuminated or kept in the dark. Hence, at the frequency at which each of the stripes is half an acoustic wavelength wide, the structure behaves as a number of half-wave transducers in cascade. The signals generated by the CdS crystal on the application of voltage pulses or mechanical pressure are acoustic waves within the crystal because of the combined action of piezoelectricity and photoconductivity. As in any grating array transducer, the bandwidth varies inversely as the number of striations. Consequently, a method of adjusting bandwidth is by the variation of the number of illuminated stripes. A change in the center frequency of operation can be affected by altering the spacing or by using a variable aperture slit.

By precise manufacturing methods, a grating array piezo-optic transducer will be able to generate, concentrate or deflect sound within a crystal by external optical control. The same structural requirements lead to insufficient photoconductivity which causes incorrect division of voltage in the crystal due to the shunting reactance of the piezoelectric material. Insufficient photoconductivity causes higher degradation at higher frequencies. Another serious threat arises from the light scattering. Although the crystal is illuminated by striated light, its dark areas also appear bright because of internal light scattering. Precision and reliability are severely curtailed by this phenomenon alone.



[illegible]32: Schematic showing the working of a quartz [illegible]ter.

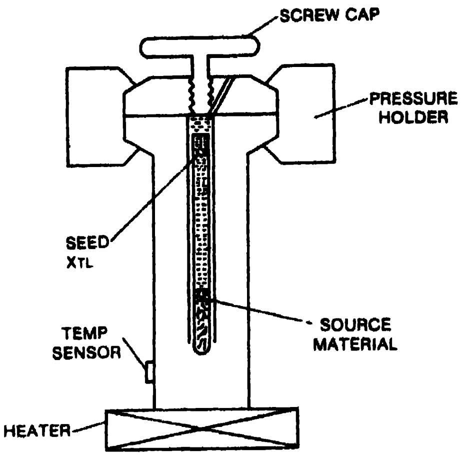


Fig. 33: Hydrothermal method to grow synthetic quartz.

Recent improvements in the development of piezo-optic materials have increased the ease of providing sharp photoconductivity without much degradation. Piezoelectric alpha-HgS (cinnabar or mercuric sulphide), a red-coloured crystal, when coupled with bulk alpha-HgS realises perfect matching in acousto-optical applications. The electromechanical coupling coefficients of cinnabar crystals are approximately two times larger than those of quartz. Measured values of coupling coefficients of alpha-HgS in thickness mode are 0.15 in X-cut and 0.24 in Y-cut, whereas alpha-SiO_2 gives 0.093 in X-cut and 0.14 in Y-cut. Both have a zero coefficient for Z-cut crystals. Indeed, the mercuric sulphide crystal is favourable to obtain wide bands for acousto-optical deflection.

Crystal pick-ups

The early bimorph revolution directly influenced the disc recording and reproduction by the introduction of crystal pick-ups. A typical stereo crystal pick-up consists of two bimorphs of Rochelle or tourmaline salts clamped at a convenient angle. Their free ends are coupled to the stylus mounting so that it receives the vibrations from the groove. Vibrations from the right-hand groove are transmitted to the left-hand arm of the square plastic framework and twist the left-hand bimorph. A proportional voltage is produced for each and every twist and turn. This does not affect the left-hand bimorph to the same extent as the right-hand one because the right-hand arm between the stylus and crystal bends about the elbow. The same level of non-interference is maintained for signals from the left-hand groove to the right-hand bimorph. Since the resulting output voltage is fairly high, equalisation circuits are seldom used for crystal pick-ups. Furthermore, their output is independent of fre-

Table IV
Nominal Values of Crystal Analogue Parameters of AT Cut

Resonant Frequency (MHz)	Series Resistance (ohms)	Series Capacitance Cs (pF)	Parallel Capacitance Cp (pF)	Q Factor X1000
1	400	0.008	2.5	45
3.58	60	0.015	3.5	40
4.00	50	0.025	5	30
5.00	40	0.02	5	20
6.00	30	0.02	6	20
8.00	20	0.02	6	20
14.31818	10	0.0265	6	50
16.0000	10	0.0319	6	50

quency and directly proportional to the magnitude of the mechanical movements. Their main disadvantages are the inferior frequency response and the changes in their characteristics due to ambient temperature and humidity changes. The next favourite, the ceramic pick-ups, are constructed in a similar manner and function almost the same way.

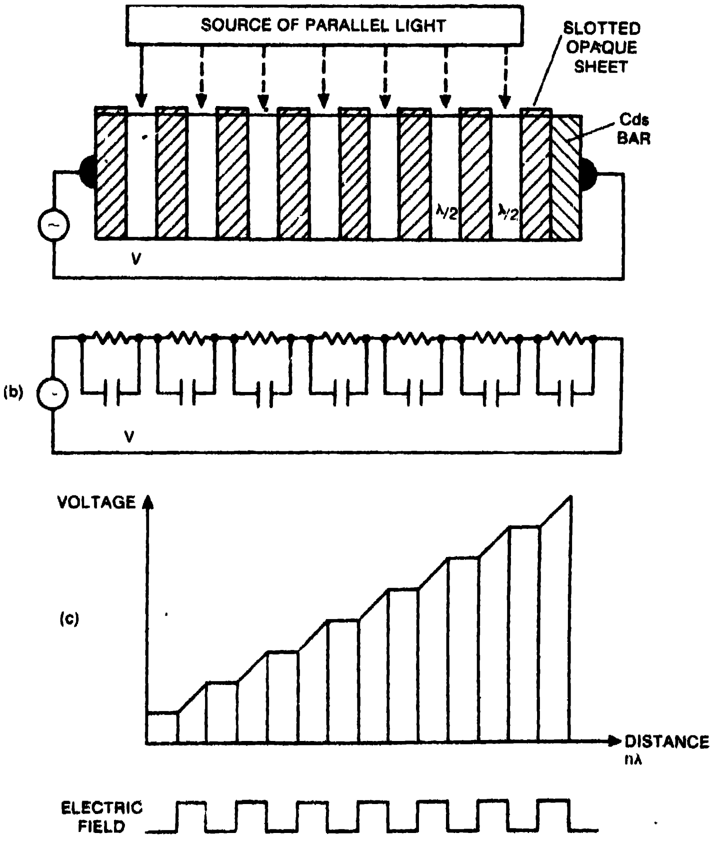


Fig. 34: Grating array transducer. (a) CdS bar with slotted opaque sheet; (b) equivalent circuit; (c) distribution of RF voltage and electric field.

The same principle has proved quite as successful when applied to the design of record-cutter heads. Piezoelectric heads contain a crystal bimorph clamped securely at one end and left free at the other. When a voltage is applied between its faces, it tends to bend or twist which is faithfully imitated by the cutting stylus attached to the free end of the crystal via a convenient linkage. This operation requires less power than the types like moving-coil or moving-iron in cutting the disc surface according to the sound signal. Yet the multiple resonance of the piezoelectric material used in the bimorph which may fall even in the audio range, the fragility of the bimorph material and its affinity towards humidity and temperature changes are some of its disadvantages.

Quartz crystals have an immense commercial viability which has been clearly realised by most manufacturers. Let us examine the case of a quartz fuse. In fact, no piezoelectric magic has crept into it. The fast acting fuse utilises a silver wire or any other suitable metal in a convenient package. When the specified current-time relationship is applied to the fuse, the wire link melts resulting in an open circuit. Usually the cartridge sleeve is covered with ceramic or high grade alumina since it can withstand sufficiently high mechanical and electrical shock. The quartz or silica is only a filler in the barrel. This type of a filler is specially dried before use and deposited within the barrel by mechanical vibrations. This form of quartz has a nominal role in the fast fusing action which is less than 4 milliseconds. When the specific current is exceeded, the heat generated vapourises the silver, and the vapour fuses with silica quartz to form a nonconducting fulgurite.

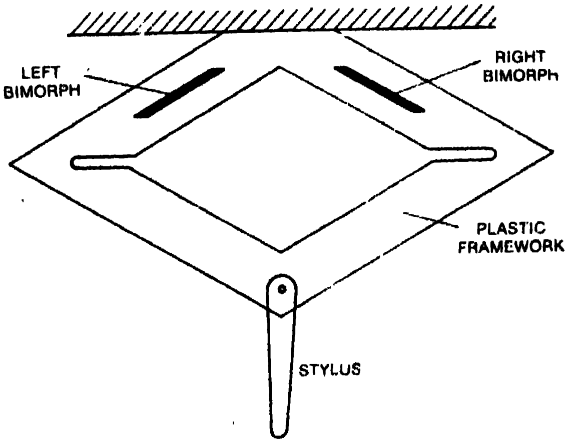


Fig. 35: Schematic of stereo crystal pick-up.

Fused silica or quartz prisms are used as wavelength selectors in spectroscopic instruments between the 0.2 to 2.7 micrometer range. It has an excellent hardness and chemical resistance. The refractive index is 1.54 while the angular dispersion is around 0.063 milliradian per micrometer at a wavelength of 0.598 micrometer as compared with the refactive index 1.7 of flint glass. Hence, quartz prisms are particularly utilised in the ultraviolet region of the electromagnetic spectrum. Renouned Cornu and Littrow prisms are also made of quartz. Even in optics, quartz has an unchallenged and enviable place.

Finally, it seems reasonable to predict that the flexibility and piezo-optic chemical properties of the material will lead to the creation of new and useful devices along with the cost-effectiveness of the integrated-circuit technology. □

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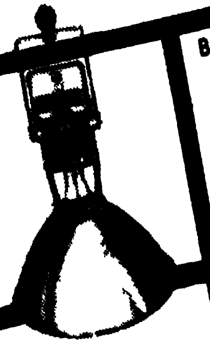

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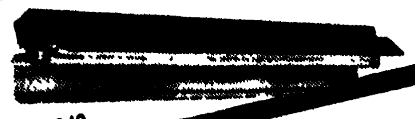

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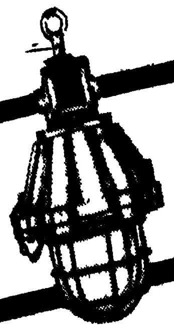

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Abacus Computers Limited has introduced a multiuser, multiterminal PC giving MS-DOS compatible software on each terminal.

For connecting each additional terminal, an add-on card which takes full size slot on Abacus PC is mounted. This gives serial connection to a terminal and keyboard, has its own Intel 8088 CPU with enhanced clock speed of 8 MHz and a minimum of 256 kB RAM. The operating system takes care of file server capabilities for the terminals. The software also has data security features for on-line usage such as file or/and record locking, log-in/log-out of users, spooling facility etc. Any terminal such as VT-100, KT7/PC or TELEVIDEO can be connected to emulate PC screen.

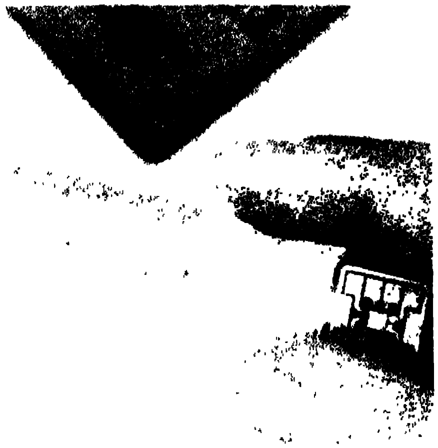
The software is geared to take care of 31 additional terminals. These can be attached through expansion cabinets. The on-line storage capacity could be 10MB, 20MB, 40MB, 52MB and 85MB hard discs and 60MB tape drives.

The add-on board has the capacity to take one more additional serial port and expand the memory to 768 kB per terminal.

On-chip credit

At the Components Salon in Paris, Siemens [W. Germany] premiered an intelligent memory in a low-profile micropack with ISO-standard contact arrangement which is suitable for credit cards. The MOS chip takes the form of an EEPROM and is thus electrically programmable and erasable. Credit cards equipped with the SLE 4401 K can therefore be reused up to 64 times.

The credit card chip presented by Siemens with a 416-bit memory capacity makes it possible to make telephone calls, fill up the car or pay for car parking without resorting to cash. Company employees will be able to pass through an automatic access check or meet a request for personal identification or proof of authorisation. Staff in companies and authorities will be able to pay for their meals in the firm's canteen without handing over cash.



The SLE 4401 K credit card chips.

The intelligent memory chip with hardwired security logic offers dual coding to protect both personal data and the system concerned against misuse. The low-profile micropack enables the chip to be embedded in a standard credit card. The chip is contacted via eight ISO-standard terminal pads which are part of the micropack and which rest flush with the surface of the credit card. Read heads with sprung tips or a similar arrangement provide electrical access to the credit card chip.

Posters can now be linked to microcomputers

Printed posters and leaflets can be linked to a microcomputer by the 'electronic display board' from Crystal Presentations Ltd, UK. This A1-size [594×841mm] touch-sensitive 'keyboard' has 225 [15×15mm] 'keys' on to which the poster or leaflet can be fixed.

Touching a particular part of the poster causes the closure of contacts within the display board and calls up a related routine on the computer-typically giving more detailed information on the item that was touched on the poster.

For educational purposes the electronic display board can be used as an index to a database on the subject of a class project.

In transport systems the poster could be a map; enquirers touching a destination might call up details of the easiest route to it or perhaps of road works causing delay.

On exhibition stands the poster could depict a range of products or services; touching one puts more information on the screen. An advanced application would be to link the poster to an interactive video display.

A starter pack includes software for the BBC microcomputer model B and an example 'electronic poster' entitled 'Travelling with Information Technology'. However, the display board can be used with any microcomputer having a user port. A program [for the BBC model B with disc filing system] enables nontechnical users to create 'electronic poster'-linked software quickly and easily.

Indian software for US computers

While they sell India computers, more and more American companies are going in for Indian software, reports UNI.

Computer makers in the United States are discovering that Indian software is a bargain, a leading American business magazine reports in a forthcoming issue.

The reason, according to Forbes, is that India is a huge pool of computer brainpower and Indian engineers cost barely half to a third of their American counterparts.

The Japanese, eager to catch up with the US in software, have also spotted India's potential, Forbes says. Last year, they set up a company in Bangalore to develop software for Japanese use.

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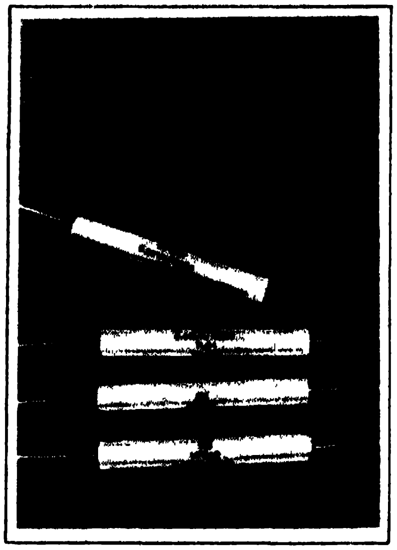

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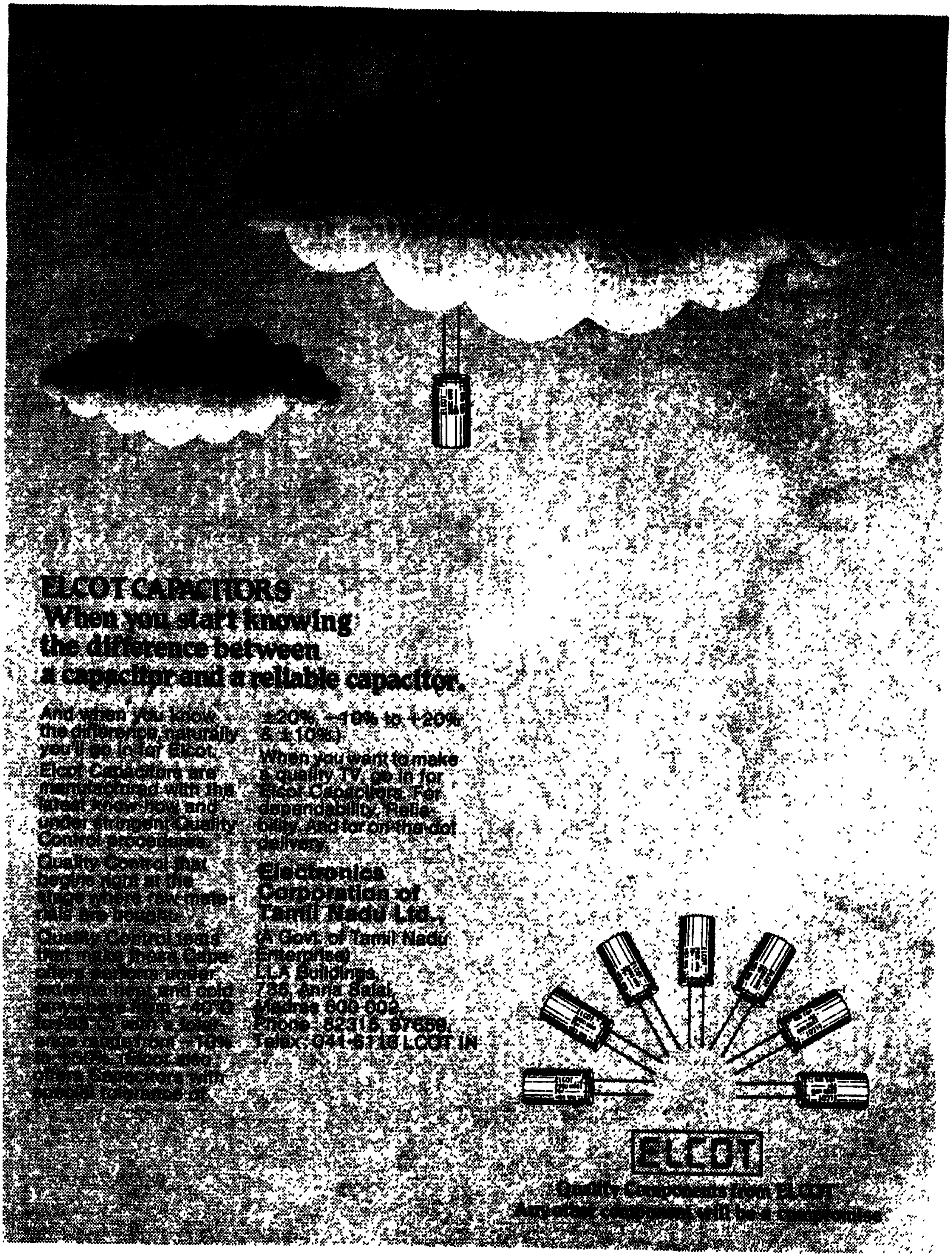

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Comparative Study of Computer Languages

Part X

Input Output Statements (1)

R. Ramaswamy

A computer uses two inputs, one is the program and the other is the data. The computer manipulates the data using the program and outputs the result. First of all we have to introduce the program into the computer. Within the program we have to give instructions to the computer to get or access the data. One may ask. "Where are the data kept? How are the instructions given to the machine to enable it to access or get the data for the given program?" Data can be accessed in a program in three ways. They are:

1. By entering the data as a part of the program.
2. By entering the data through the console typewriter.
3. By asking the computer to get the data by reading the file in which data are already stored.

In this article, we shall consider the instructions to be given to the computer to get the data for a program by the first two methods. The function of an input statement is to get the data for the given program by any of the above three methods. The way in which the input instructions are given may be different in different languages.

Function of the output statement

The computation statements give instructions to the computer to compute the result and store it in some variables. In order to transfer the result stored inside the computer to the printer and print the result on paper, we have to give instructions to the machine. Such instructions are given by the output statements.

The computer can be instructed to print the result on paper or on any machine-decipherable medium.

Input statement in FORTRAN (data access through console)

As already mentioned, an input statement is an instruction to the computer to read the data for the variables involved in the expressions used in the program. The general form of an input instruction is:

```
READ (m,n) list
```

READ is simply a code word to the machine. For being meaningful, the word READ is used. The list contains the list of variables whose values are to be read. Each of these variables is separated by a comma. The letters 'm' and 'n' need some explanation.

The data are entered into the computer line by line. Each line can hold only 80 characters, i.e., the line length is 80 characters. We have to tell the computer the mode of each data, the columns in which they are entered in the given line etc. Such information is given in another statement called the FORMAT statement. For reference purposes statements are numbered in FORTRAN. The letter 'n' is an integer number which represents the number of the FORMAT statement which gives information to the computer about the data list given in the READ statement. Then we have to tell the computer whether the data forms part of the program or whether it should be stored outside the program. This information is given by an integer number given by 'm' which is also called the logic unit number of the input device.

In this case, we wish to enter the data through the console typewriter attached to the machine. For this device, the value 1 is assigned. So we shall give the value 1 to 'm'. When the data is stored in the diskette, we may have to give different numbers to 'm' (which we shall see later). Suppose we want to read the values of three variables, say, A, B and C. We can write the READ statement as follows:

```
READ (1,10) A, B, C
```

The number 10 gives the number of the FORMAT statement which gives information to the computer about the mode of the values of the variables in the list (integer or real) and the columns in which the values are given. A READ statement is incomplete without the corresponding FORMAT statement. The READ and the FORMAT statements always occur in pairs. The general form of a FORMAT statement is:

```
n FORMAT (s1, s2, s3)
```

where 'n' is the number of the statement which has been referenced in the READ statement. FORMAT is simply a code word which means the form in which the data are given. s1, s2 and s3 are the specifications required for the computer to locate each of the data items specified in the READ list. We have given three variables in the READ list. So there must be three specifications in the FORMAT statement. There must be as many specifications as there are variables in the READ list.

Before describing the different format specifications, the general form of the output statement should be understood since its structure is similar to the input statement. Both the input and output statements occur in pairs with their corresponding FORMAT statements. That is, the READ statement occurs along with its corresponding FORMAT statement and the WRITE statement occurs along with its corresponding FORMAT statement. The FORMAT statements for READ and WRITE are very similar.

Output statement in FORTRAN

The general form of the output statement is:

```
WRITE (m,n) list
```

The word WRITE is simply a code word to the machine. This code is used because it is meaningful to the humans. We must tell the computer whether the result is to be printed on paper or any other medium. This is given by the value we assign to 'm'. If we want the output through the printer, the logic unit number for the printer is 2. The word list stands for the list of variables whose values are to be printed. We have to tell the computer in which mode, in which line and in which column the values of the variables in the list must be printed. This information is given in the FORMAT statement.

The letter 'n' stands for an integer number which references the FORMAT statement. Suppose we want to print the values of three variables A, B and C on paper, we write the output statement as:

```
WRITE (2,10) A, B, C
```

The number 10 refers to the number of the FORMAT statement which gives specifications for the variables A, B and C. The general form of the FORMAT statement is:

```
n FORMAT (s1, s2, s3)
```

where 'n' is the statement number of the FORMAT statement and this must be referenced in the corresponding WRITE statement. The word FORMAT is simply a code, meaning the form in which the output is required. s1, s2 and s3 give the specifications for each of the variables A, B and C.

There must be as many specifications as there are variables in the WRITE list. If the FORMAT specifications are less than the number of the variables in the list, an error condition arises. If the FORMAT specifications are more than the number of the variables in the list, the extra specifications are ignored by the computer. The READ and WRITE statements in FORTRAN have similar structures as shown below:

```
    READ (1,10) A, B, C            WRITE (2,12) A, B, C
 10 FORMAT (s1, s2, s3)         12 FORMAT (s1, s2, s3)
```

There are a number of FORMAT specifications in FORTRAN. The following are the different FORMAT specifications used in FORTRAN for input and output.

The I-FORMAT

The I-FORMAT is used to represent integer quantities. The general form is:

```
Iw
```

where the letter 'I' indicates that the entity is an integer and the letter 'w' indicates the width of the field in terms of the number of digit spaces required for the number. The width includes one space for the sign. The space for the sign is optional at the input, but is compulsory at the output. That is, if a sign is explicitly put at the input only then space must be allotted, otherwise no space for the sign need be allotted. For output, whether the sign is explicitly present or not, one space for the sign must be given. Suppose you want the computer to read a number 234 in the variable I. Then the READ statement should be written as follows:

```
    READ (1,10) I
 10 FORMAT (I3)
```

I3 specifies that the number 234 is keyed in the first three columns. Suppose you key the number as +234, then you must give a specification I4. If you want the number 234 to be output, write the WRITE statement as follows:

```
    WRITE (2,12) I
 12 FORMAT (1X, I4)
```

One must give a specification I4, i.e., four spaces must be given for outputting a three-digit number. The number is printed from the second column onwards, leaving the first column blank. If the value of I is -234, then the number is printed with the sign in the first column. Suppose you give a specification I19. In that case, the number is printed in the columns 17, 18 and 19. That is, the number is printed right-justified in the given field width. To read more than one variable, the READ statement is written as:

```
    READ (1,10) I, J, K, L
 10 FORMAT (I3, I4, I5, I7)
```

The four specifications in the FORMAT statement correspond to the four variables in the READ list. One must key the data as follows: the value of I must be punched or keyed in the first three columns, the value of J must be keyed in the next four columns, the value of K must be keyed in the next five columns, and the value of L must be keyed in the next seven columns. The data must be keyed right-justified in the respective fields.

If the value of I is 23, J is -24, K is 456 and L is 750 and one writes a WRITE statement as follows:

```
      WRITE (2,12), I, J, K, L
   12 FORMAT (1X, I3, I4, I5, I7)
```

then the value wil be printed in one line as follows:

```
b23b-24bb456bbbb750
```

where the letter 'b' stands for blank. If we give the same field width for all the items, say 7, the FORMAT statement is written as follows:

```
   12 FORMAT (1X, I7, I7, I7, I7)
```

The repetitive specifications can be simplified by using the replication factor as:

```
   12 FORMAT (1X, 4I7)
```

Since the specification I7 is repeated four times, we say the replication factor is 4 and write the specification as 4I7. The four numbers will then be printed in one line as follows:

```
bbbbb23bbbb-24bbbb456bbbb750
```

The following examples illustrate the printing for different specifications.

Value stored	**Specifications**	**Printed output**
234	I4	b234
234	I3	error message
-234	I4	-234
234	I6	bbb234
-234	I8	bbbb-234

In order to output a number with three digits, we have to give four spaces, otherwise an error message appears. In general, one has to give k+1 spaces to output an integer with k digits. If the field width is more than the size of the number, then blanks are given on the left side, printing the number right-justified in the given field.

The 1X specification

In the FORMAT statement associated with the WRITE statement, the specification 1X was introduced. This is called the carriage control specification. The FORMAT statement in a WRITE-FORMAT pair tells the computer the mode of the data, the length of the data and where they should appear in the output stream. In addition to this, the computer also requires information about the movement of the printer head. This information is given by the carriage control character. This character tells the computer whether the results are to be printed giving single spacing or double spacing or whether they must be started on a new page or written in the same line. One character position is reserved in the first column to give this information. Invariably, no data must be specified in the first column. If by chance, data is specified in the first column, there is every possibility of the first character of the data being chopped off.

One must be careful in allotting the first character of the output FORMAT for indicating the carriage control. For example, a specification 1X for the first character will be ken to mean that the results must be printed giving single line spacing. A specification 1H+ means that the printer carriage must not advance after printing that line. A specification 1H1 means that the results must be printed on a fresh page.

The specification given in the first column does not affect the actual print length of the result. If the printer has 132 columns width, specification for printing all the 132 columns can be given and the carriage control character, though read in the first column position, is not counted for printing purposes. This means that specifications for 133 columns can be given, the first column space specification being exclusively for the carriage control information which is not used for printing.

Carriage control specifications

The table below gives the coding of the different carriage control specifications and their meanings.

First specification in the FORMAT statement for printing a line	**Coded as**	**Printing-paper movement before printing**
b (blank)	1X or ' '	Advance one line (normal single line spacing)
0	1H0 or '0'	Advance two lines (double line spacing)
1	1H1 or '1'	Advance to the top of the next page
+	1H+ or '+'	No paper movement. Print the next line over the same line

The carriage control character is not used during the READ statement and so no such specification is given to the FORMAT statement associated with the READ statement.

The F-FORMAT

The F-FORMAT is used for specifying numbers in the floating point form. The general form of the F-FORMAT is:

```
Fw.d
```

where 'w' is the width of the field including the digits, the sign and the decimal point, and 'd' is the number of digits to the right of the decimal point. If we have three variables A, B and C and read the values 432.2, -234.6 and 2345678.9 respectively in them, we can write the READ statement as follows:

```
      READ (1,10) A, B, C
   10 FORMAT (2F6.1, F10.1)
```

When the computer encounters the READ statement, the operator has to key the first value in the first six columns, the second value in the next six columns and the third value in the next ten columns. For outputting these values, the WRITE statement is written as follows:

```
      WRITE (2,12) A, B, C
   12 FORMAT (1X, 2F6.1, F10.1)
```

The result is then printed from the first column onwards as shown below:

```
b432.2-234.6b2345678.9
```

Remember that in all cases, if the allotted width is less than the size of the number, an error message is given, and if the allotted width is greater than the size of the number, the number is printed right-justified leaving blanks on the left.

The E-FORMAT

The E-FORMAT is used to represent real numbers in the exponent form. The general form is:

```
Ew.d
```

where 'w' gives the total width of the field including one for the sign, one for the decimal point, four for the exponent notation, and the remaining spaces for the digits in the mantessa to a maximum of eight. A number like 23456789000.00 can be represented as .23456789E+11 in the exponent notation. The above notation requires 14 spaces including one for the sign of the mantessa. To read this number in the variable A, the READ statement can be given as:

```
    READ (1,10) A
 10 FORMAT (E14.8)
```

and to output the number in the E notation, the WRITE statement is given as:

```
    WRITE (2,12) A
 12 FORMAT (1X, E14.8)
```

The number is then printed from the first column as

```
b.23456789E+11
```

If the FORMAT specification is given as E16.8, then it is printed as

```
bbb.23456789E+11
```

While giving the formats for outputting the results, sometimes the order of magnitude of the numbers may not be known. If by chance an insufficient FORMAT specification is given, the computer gives an error message. To avoid this it is better to give a format which outputs the biggest as well as the smallest number that is permitted in FORTRAN. The format E14.8 can output the biggest as well as the smallest number that can be output in FORTRAN. So it is always safe to use this format.

The A-FORMAT

So far we have seen formats for reading and printing numeric entities. If we want to read and write alphanumeric characters, we use the A-FORMAT. The general form of the A-FORMAT is:

```
Aw
```

where 'A' is a code to tell the computer that the data is alphanumeric and 'w' is the width of the field in terms of the number of characters including blanks. In general, the number of characters that can be read or printed under the A-FORMAT is small, i.e., only up to a maximum of four characters. To read the word 'KRIS' in the variable X, one can write the READ statement as:

```
    READ (1,10) X
 10 FORMAT (A4)
```

To write the value of X in the A-FORMAT, the statement can be given as:

```
    WRITE (2,12) X
 12 FORMAT (1X, A4)
```

Then the computer prints the word from the first column as:

```
KRIS
```

If the name of a person is longer than four characters, it can also be read by using subscripted variables. One can READ or WRITE only up to a maximum of four alphanumeric characters in the A-FORMAT.

FORTRAN does not allow the assignment of alphanumeric values to a variable in an assignment statement. For example, one cannot write:

```
X = 'KRIS'
```

This means that characters cannot be manipulated in storage. This is one of the reasons why this language is not quite suited to business problems where there is a lot of character manipulation.

The H-FORMAT

Though FORTRAN does not provide facilities to manipulate characters in storage, it provides facilities to print long character strings during output with the help of the H-FORMAT or the Hollerith FORMAT. The general form of the H-FORMAT is:

```
wHxxxxxxxx.....,
```

where 'H' is a code word to indicate that the characters following it are in a string form and 'w' is the width of the Hollerith string. That is, it is an integer specifying the number of characters following the letter 'H' including the blanks up to the next comma. The letter 'x' stands for each alphanumeric character.

Suppose the computer is asked to calculate the volume of a box, given by the variable V. If the value of V is 500 cc, and if we ask the computer to print V, it simply prints 500. Obviously this is meaningless. To make the computer print the result as 'VOLUME OF THE BOX IS 500 C.C.', the descriptive words before and after the result can be output by using the Hollerith FORMAT as follows:

```
    WRITE (2,12) V
 12 FORMAT (1X, 21HVOLUMEbOFbTHEbBOXbISb,
     F5.0, 5HbC.C.)
```

The computer then prints as follows:

```
VOLUME OF THE BOX IS 500. C.C.
```

The characters between the letter 'H' and the next comma are printed as they are. If the counting of characters and blanks up to the next comma is not exact, the computer gives an error message. It must be noted that the Hollerith field is used only at the output. The H-FORMAT cannot be used in the READ statement since H-field characters cannot be manipulated in the memory.

The OTE FORMAT

FORTRAN provides another method for outputting character strings since counting of characters and blanks in a Hollerith string is a common source of error. The string data is simply enclosed within single quotations. Whatever is within the quotation marks, including blanks, is printed by the computer as is in the H-FORMAT. One can write the statement as below:

```
     WRITE (2,12) V
  12 FORMAT (1X, 'VOLUME OF THE BOX IS', F5.0,' C.C.')
```

The computer prints the output as follows:

```
VOLUME OF THE BOX IS 500. C.C.
```

The Slash (/) FORMAT

The Slash-FORMAT is used to skip over to a new line when the output is printed. A slash between two specifications means that the value of the variable immediately after the slash must be printed from the next line or next record. (A line is also called a record.) No commas are necessary to set off a slash specification, but they can be added for better readability This specification can be repeated any number of times. For skipping one line one slash is used. For leaving n lines blank, n+1 slashes are used. Suppose one writes:

```
     WRITE (2,10)
  10 FORMAT (1X, 'CHAPTER XII', /, 1X, 'SUBROUTINES')
```

then the words CHAPTER XII and SUBROUTINES are printed in two consecutive lines from the first column onwards as shown below:

```
CHAPTER XII
SUBROUTINES
```

If no slash specification is given in the FORMAT statement, both the words are printed in the same line. The Slash-FORMAT can also be used during input to skip lines.

The X-FORMAT

Just as the Slash-FORMAT is used to skip a line, the X-FORMAT is used to skip some columns in the same line. The general form is:

```
wX
```

where 'w' refers to the number of blank spaces to be left before the next word is read or printed and 'X' is the code to indicate blank space. Suppose we want to print the words CHAPTER XII and SUBROUTINES in two lines leaving ten columns blank in the beginning of each line, we can write the statements as follows:

```
     WRITE (2,12)
  12 FORMAT (1X, 10X, 'CHAPTER XII', /, 11X, 'SUBROUTINES')
```

The carriage control character specification 1X can also be included in the X specification. The computer prints the two words in two lines starting from the 11th column as follows:

```
          CHAPTER XII
          SUBROUTINES
```

Matching list elements with format codes

When the (number of) list elements in the READ or WRITE statements have one-to-one correspondence with the (number of) format codes, there is no problem. When the last element is read or written, the format codes also are exhausted and the execution of the input/output statement is complete. However, two conditions may arise which are worth noting:

1. There are more format codes than there are elements in the corresponding list.
2. There are more elements in the list than there are format codes.

The first situation is illustrated by the following example:

```
     READ (1,10) A, B, C, D
  10 FORMAT (7F10.2)
```

As a rule, when there are more field specifications than there are variables in the list, the execution of READ/WRITE statement is completed once the variables in the list are exhausted by READ/WRITE operations and the extra specifications are ignored. The computer after reading A, B, C and D as per F10.2 FORMAT, ignores the three extra specifications. The second situation is illustrated by the following example:

```
     READ (2,12) A, B, C, D
  12 FORMAT (F10.2)
```

The sequence of the field codes in a FORMAT statement refers to a complete record or one line. When the first field is read from the READ list, the format code is exhausted. For reading the next field, it looks to the next line and uses the same format code. The third field is read from the third line and the fourth field from the fourth line. The computer cannot read all the data from the same line. If all the data are keyed in the same line, the computer gives an error message.

The general rule is that when the list of variables in the READ statement is greater than the number of format specifications in the FORMAT statement, a single READ statement causes additional lines to be read until all the required data are obtained. When a READ/WRITE statement demands more format codes than the FORMAT statement appears to have, the format control always returns to the last left parantheses in the FORMAT statement and thus to a new line. Suppose we write:

```
     WRITE (2,12) A, B, C, D
  12 FORMAT (1X, F8.2)
```

In this example, four variables are given in the list in the WRITE statement, whereas there is only one FORMAT specification. In this case, the same format is re-used until all the values of all the variables are printed. Each value is printed in a separate line.

Thus we see that every READ statement must be accompanied by its own FORMAT statement and every WRITE statement must be accompanied by its own FORMAT statement. When the computer encounters the READ statement, it stops and waits until the values for all the variables in the list are keyed through the console as per the FORMAT specification given. If the FORMAT specification is not adhered to, the computer gives an error message. Whenever the computer encounters the WRITE statement, it prints the values of the variables in the list as per the FORMAT specification given. If the WRITE-FORMAT specifications are incorrectly given, the computer gives an error message. Please remember that the computer is very particular about grammar and not even a small slip is permitted.

Input statement for entering data

The DATA statement which is placed in the beginning of the program enables the program to get the data within the program itself. The general form of the data statement is:

```
DATA list/ values/
```

The word DATA is simply a code word to indicate that data values are given in this statement. The list contains the list of variables whose values are to be given. Each of these variables is separated by a comma. The values which are put within two slashes, contain the values of the variables in the list in the same order, separated by commas. Suppose the variables, A, I and K are to be given values, it can be given by the following DATA statement:

```
DATA A, I, K/234.5, 678, 87/
```

This statement means that A is assigned the initial value 234.5, I is assigned the initial value 678 and K is assigned the initial value 87. There is no FORMAT statement for this method of entering data to the variables. One can also give character data to variables as shown below:

```
DATA A, B, C/'KRIS', '*', '/
```

To give another set of data for the same variables, you cannot give another DATA statement in the program to re-initialise the values of the same variables. But different values can be given using assignment statements. For example, to give a value 56.7 to A, 34 to I and 67 to K, write the assignment statement as shown below:

```
A = 56.7
I = 34
K = 67
```

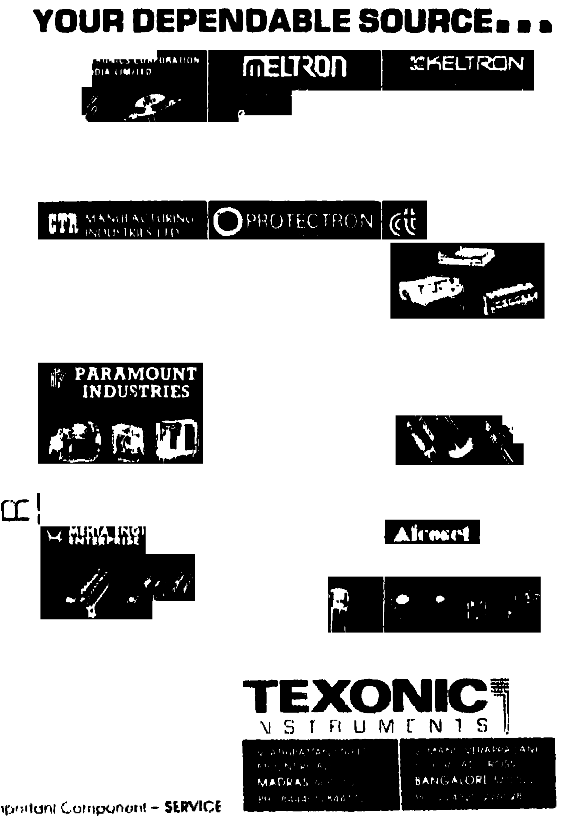
In fact, the assignment statement method is one of the ways of entering data to the program.

So far we have seen two methods for entering data in a FORTRAN program. In the first method, instructions are given to the computer to enable it to enter the data through the console typewriter attached to it. This is done by the READ-FORMAT pair of statements. In the second method, data are entered as a part of the program itself by means of the DATA statement.

When the volume of data is small these two methods may suffice. But in practice, data is usually voluminous. In such cases, more effective and efficient methods for entering data into the program are available. This is done by storing data in files and then asking the computer to read the files and get the data for the program. For outputting the result, the computer can be asked to print the same either on paper or on floppy diskettes. The former is called the paper file and the latter is called the computer file. The paper file is meant for the humans and the computer file is meant for the machine.

A file is simply an information storage media. Humans store information on paper. Since information on paper medium cannot be deciphered by the machine, the computers store the information in a different medium which is machine decipherable, i.e. the floppy diskette. Information stored in floppy diskettes is said to be stored in computer files. Just as we read a paper, the computer reads what is written on the computer file. Just as we write on paper, the computer writes on the computer file.

(To be continued)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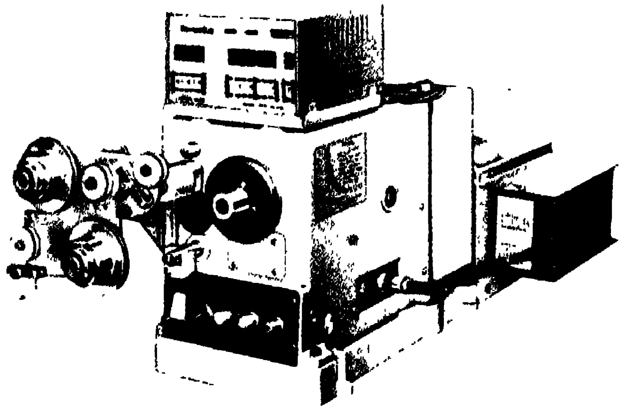

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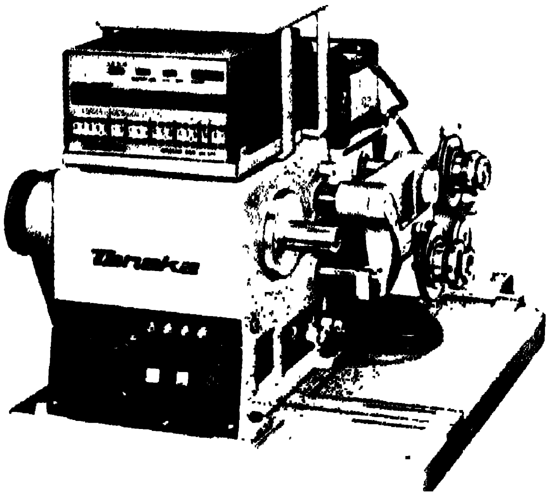

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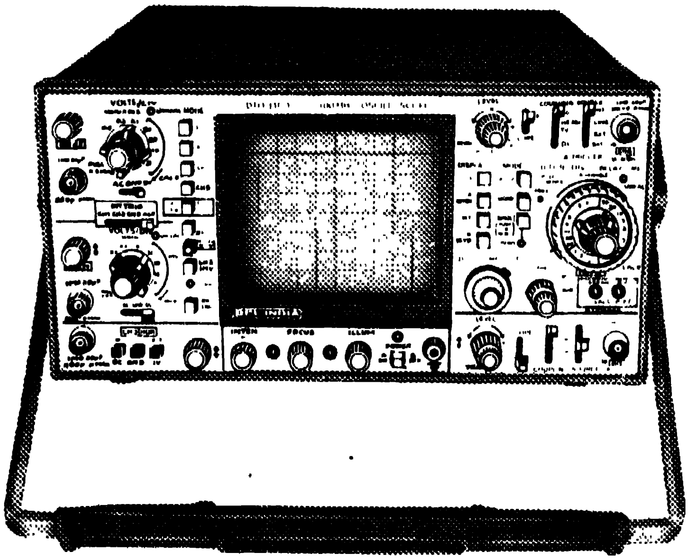

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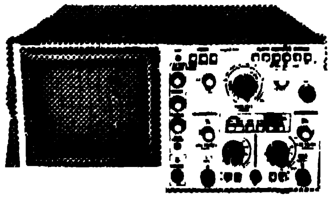

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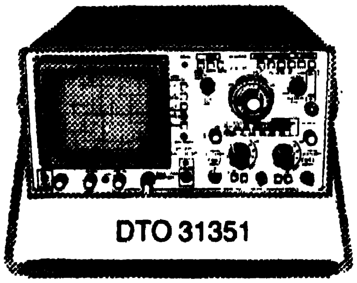

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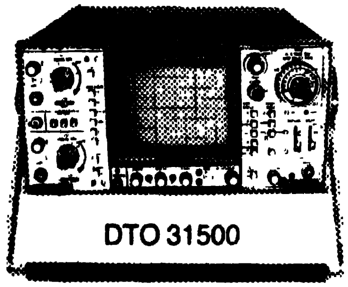

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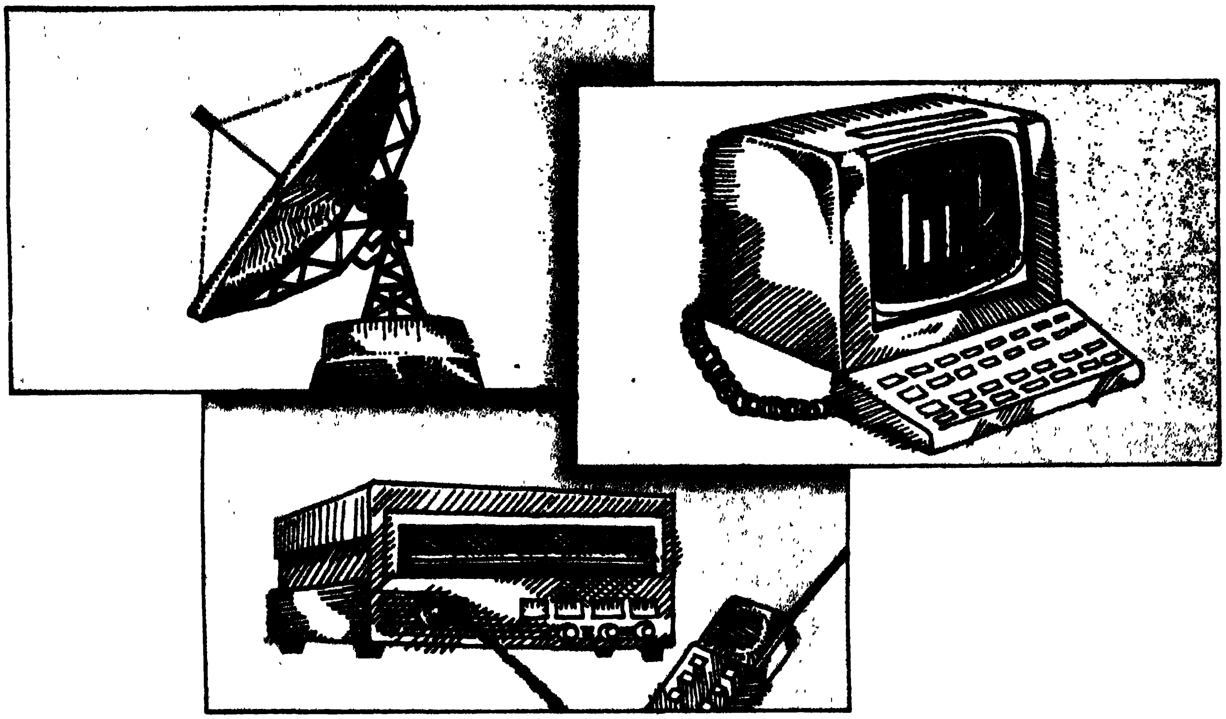

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Structured Programming

Suresh K. Basandra

Data processing managers are increasingly realising the importance of programming function in computer installations. A lot of effort in terms of time, money and manpower is involved in programming and systems analysis. In addition, much of the programming effort is directed towards program maintenance, i.e. changes in, or modifications to, existing programs. In such an environment, traditional programming comes into conflict with cost management objectives.

Traditional programming means programming generated as a form of personal art without adherence to established concepts and principles. The traditional way has been to view programming as a personal creation by an individual. It is quite possible for a programmer to write a clever program for solving a problem—the word 'clever' is often synonymous with 'complex' and 'obscure'. The difficulty with such a program is that it is hard to understand by persons other than the author and even the author may find it difficult to follow it after a long gap of time.

The recent past has seen a spectacular decrease in the hardware costs of computers. This trend is still continuing. As a result, cost of personnel relative to the hardware costs is increasing at a rapid rate. This calls for methods that can increase the personnel performance and thereby reduce the cost of program development. Quite often, the purpose for which a program is developed gets changed. In such cases, there are two alternatives: either the program should be declared obsolete and a new program developed in its place or the program should be modified incorporating the necessary changes.

The cost of personnel being on the increase, the question of discarding a program altogether does not arise. So, the program should be maintained by modifying it. This again calls for methods for program development so that the program is understood and modified easily. Programmers have, therefore, been attempting to find ways and means of writing correct programs which can be easily maintained, modified and debugged; for, such factors tend to become very important, especially in a rapidly changing business environment where similar programs have to be run frequently. This effort has led to the development of a programming discipline called structured programming.

As with all new concepts, there is considerable disagreement and misunderstanding as to what structured programming means. In fact, there is no standard definition of structured programming except that it is a disciplined approach to programming. In general, the term 'structured programming' has come to mean a collection of principles and practices that are directed towards developing correct programs which are easy to understand and maintain.

Some programmers insist that they have been using this technique for a long time. This may well be true, but the recent emergence of this technique has evolved from an attempt to formalise the process of designing programs in the same manner as the logic design has been formalised. The techniques used are, in general, not new but the formal basis definitely is.

Design considerations

The process of designing and writing a program can be sub-divided into a number of tasks such as:

(a) understanding the problem;
(b) producing an algorithm to solve the problem;
(c) coding the algorithm in a particular language;
(d) testing the resultant program; and
(e) iterating round the above tasks until the program is correct.

In conventional programming, tasks (a) and (b) are undertaken by the systems analyst and (c) and (d) by the programmer, with (e) being shared between both. This decomposition process can be thought of in a number of ways but structured programming would suggest that it should be looked at as a top-down analysis, i.e. each stage is an elaboration of the previous stage with a greater degree of detail and complexity. This means that the problem is initially specified at a relatively low level of complexity and detail, and that the problem is gradually elaborated to produce the final program by stepwise refinement.

The nature of the difficulties involved in each step depends upon the problem and on the constraints on its solution, such as the resources available. The main difficulty in any problem-solving situation is to contain the complexity of the problem. It is this complexity which provides the intellectual challenge for programming. In structuring the solution, an attempt is made to simplify the complexity and to aid understanding. This approach is more likely to result in a correct solution.

Structured programming offers a number of benefits to its users. In this programming, each step is independent of the other steps, hence allowing separate checks at each step. Each step may be verified by checking the elaboration stage by stage and an error may, therefore, be detected in a systematic manner. At any one time, only a small amount of information has to be remembered and manipulated and the structure evolved is suitable for a rigorous proof of the correctness of the entire algorithm.

Objective and principles

The objective of structured programming is to provide methodologies so that:

(a) programs are developed quickly and with fewer mistakes;

(b) programs are read and understood easily; and

(c) a portion of the program can be modified without upsetting the functions of other portions.

In other words, the objective is to meet the challenge offered by the changing trends in data processing. The principles of structured programming are as follows:

(a) structuring of control flow;

(b) decomposing a program into 'modules' or 'partitions'; and

(c) top-down approach towards program designing.

These principles and the methodologies to implement them are outlined below.

Program structure

A computer program is a set of instructions to the computer. But while the instructions are to be executed by the computer, the language in which we communicate these instructions is meant to be comprehensible to humans. High-level languages like COBOL are intended for human use in their direct form and are intended for machine use only indirectly, through the process of compilation. Therefore, a basic principle of good programming is that the program be easily understood.

A program that can be understood can also be analysed and tested for correctness. Incorrect programs have plagued computing from its early days. Another basic principle of good programming then is to write correct programs. In a more theoretical vein, we talk of proof of program correctness as a reflection of efforts to prove in logical and unambiguous terms that a piece of program code is correct, i.e. it does what it is intended to do and nothing else. Theoretical progress has been made only in very limited contexts, and at present we cannot rely on a formal theory to guide us to produce correct programs. Instead, we rely on a number of rules and guides that are closer to commonsense than they are to a formal theory.

Every program has a structure. If the structure is well-defined, the program is correct and easy to understand and modify. On the other hand, a poorly structured program may have errors that are difficult to detect, may be hard to read and may be troublesome to modify. In cases where a change has to be made, it may become necessary to scrap the whole program and start afresh with a new one. In contrast, a structured program is characterised by clarity and simplicity in its logical flow structure. It reads like ordinary language from the beginning to the end, instead of branching from later paragraphs to earlier ones and back again. So, a simple, straight flow of logic is another principle of good programming.

Programming by itself is a complex task and the aim of structured programming is to reduce and control complexity as it is not possible to eliminate the complexity completely. Human intellect can comprehend only a limited amount of data at a given time. When human mind is faced with a complex task, it tries to manage by breaking it into a series of well connected smaller parts. Each smaller part or module, as it is called, is simple and comprehensible by itself so that within each module, all simplicity and clarity is achieved. So one of the characteristics of a well structured program is that it consists of a large number of small modular programs. Each modular program is self-contained and performs a single function. Each module can be tested and debugged independently.

This means that every module has only one input and one output point, though within the module there may be branches and loops. Of course, the programmer has to use his commonsense in dividing the complex program into a large number of smaller self-contained units or modules. Since each module has a specific independent function, it can be perfected separately without mixing it with the other parts of the program. This is indeed a simplification of the programming art.

How is a modular structure developed? In practice, a modular structure is developed by proceeding from the general to the specific, or by using what is widely known as the top-down approach. Starting with the barest specification of the problem, one goes about filling the details. Suppose we are to develop a pay-roll processing problem utilising the top-down approach. The most abstract statement of the task is 'write pay-roll'. Then one can proceed to breakdown this general statement to more specific statements, such as:

Edit input data
Process against master file
Output pay-roll checks and other reports

Each of these broad functions can be subdivided into more specific ones, as for example, we can divide the first job still further as follows:

Check the valid employee number
Check time card data against job tickets
Check for valid department number, and so on.

The first program module which may be called the Read Module performs a certain function after making all checks as given by commands or statements within that module. The main point is that the execution of commands or statements within the module has nothing to do with statements in other modules and that is why we say each module can be independently developed, tested and debugged. In the overall structure of the program each module is taken as a single instruction.

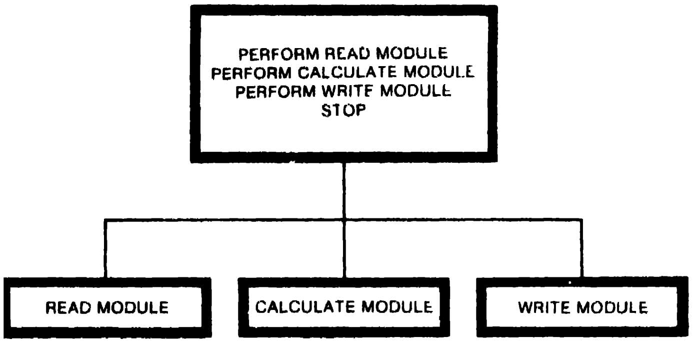

Fig. 1: Modular hierarchy diagram.

If a problem can be divided into, say, five modular functions, the main program can be considered to be made of five independent instructions, each instruction performing a module. A program organisation is, therefore, first divided into modular organisation and then each module is further divided into a statement organisation. Just as a government organisation performs the governing function by a hierarchy of officials at different levels, a complex programming task is achieved by dividing the job among different modules organised in a particular hierarchical structure. This is the top-down approach and this seems to work well in all human tasks. Fig. 1 shows what is called modular level or modular hierarchy diagram of the above problem.

It should be noted that no programming language is used when developing a programming structure. The thoughts are simply written in ordinary language with or without graphic aids such as arrows, boxes, brackets etc and the whole function is divided into a large number of simpler functions in a logical way. So, structured programming is not concerned with any particular language. It is concerned with programming in general.

Structuring of control flow

Except for the most trivial examples, programs are highly complex systems of logic. The ability to design loop operations and to take alternative courses of action depending on a condition can make a program very complex. This is because, quite often, loops are used within alternative paths or loops and alternative paths are used within loops or other alternative paths. The large size of a program and the interconnections between its various parts through the transfer of control also increase the program complexity.

The idea behind the structuring of control flow is to keep this complexity under control so that the design and understanding of the program logic become easier. It has been demonstrated that a structured program can be completely developed using three basic forms of program structure, viz. (i) sequence structure, (ii) decision or selection structure, and (iii) loop structure. One may encounter these as special terms which are written: SEQUENCE, IFTHENELSE, DOWHILE.

Sequence structure. The SEQUENCE structure indicates the sequential flow of program logic. Each block may stand for a statement; it may stand for a whole module or even a collection of modules. In a SEQUENCE structure the statements are executed one after the other in the order in which they are written. The flowchart of such a structure is shown in Fig. 2. The flow of control is such that it performs the block A first, then the block B, and so on, from top to bottom in the same direction. There is only one entry point

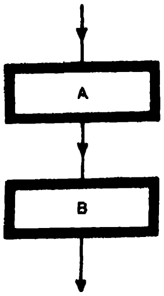

Fig. 2: Flowchart of the SEQUENCE structure.

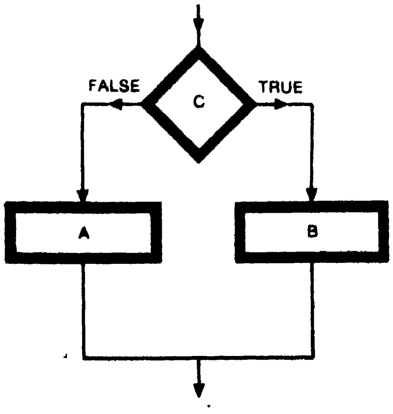

Fig. 3: Flowchart of the IFTHENELSE structure.

and one exit point for the structure and there is no complexity. The flow is in one direction and straightforward.

Decision structure. The IFTHENELSE structure indicates conditional program flow. The program takes one path or another, depending on whether a condition, often referred to as the predicate, is true or false. The program on entering the test box C in Fig. 3 makes a decision to go through either of the two paths A or B. After performing one of the two paths, the control returns to a single exit point. It can be seen that this structure also has one entry point and one exit point, even though there are multiple exit paths inside the structure.

Loop structure. The DOWHILE structure provides for a looping operation, i.e. repetitive execution of a program segment. A loop is not infinite if it is correct. The predicate tests for a condition. If the condition holds, we exit from the loop; if not, we execute the instruction. The flowchart of this structure is shown in Fig. 4. Whether the operations are to be repeated or stopped is decided in the decision box.

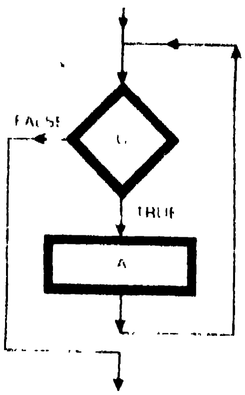

Fig. 4: Flowchart of the DOWHILE structure.

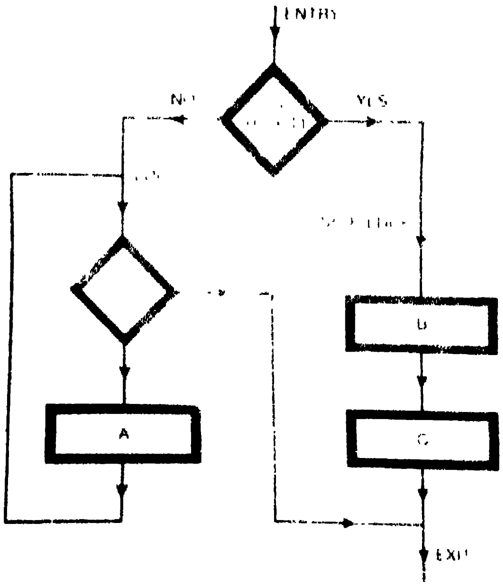

Fig. 5: Flowchart of the nested structure.

Any program can be written by using these three structures as the basic building blocks. In complex programs, one structure may be embedded in the other. For example, in Fig. 5, a nested structure is shown. When selection between the two available paths is made in the decision block C1, the control enters either a loop structure on the left or a sequence structure on the right. After performing anyone of the two paths, the control returns to a single exit point. In a similar manner, any number of structures can be embedded, provided the combination as a whole has one entry point and one exit point.

Modular programming

Modular programming is a programming strategy where a program is divided into a number of identifiable partitions or modules. Thus, a module in itself is a proper program structure. It has one entry and one exit, reads naturally from top to bottom, and may consist of any of the three basic program structures (SEQUENCE, IFTHENELSE, DOWHILE). The module is referenced by a name which should be as descriptive as possible. In COBOL that name is a paragraph or section name. A module should not exceed one page in length so that it is easily read. Finally, each module is executed by reference to it from another part of the program, usually through the PERFORM verb.

Fig. 6 depicts a general outline of structured programming logic. Note that there is a main logic module and a number of other dependent modules. The main logic part provides a summary of the program, and it is generally short enough so that the essence of the entire program can be understood in the context of the main module. Notice that module A, for instance, is executed under control of the main program module. If the name of module A is meaningful, say, Compute - total-deductions, we need not bother with the details of module A.

It may very well be the case that, as in this example, module A is sufficiently large or complex so that we need to break a module X out of it. Thus, module X is executed under the control of module A which in turn is executed under the control of the main module. This nesting of modules is permissible and desirable. We only need to keep in mind that as soon as the end of a module has been reached, we should turn to the module which issued the execute instruction. Thus, when module X has been executed, we return to instruction 2 of module A and, to the PERFORM MODULE B instruction of the main program module.

The program structure described above is adequate for most data processing. However, there are two conditions that restrict its use. Some tasks are common to more than one program. Repeating the same instructions in each such program is undesirable. The second case concerns large programming tasks. It is difficult for a team of programmers to work on the same program at the same time. It is easier to sub-divide the composite task into independent program modules that can be written, compiled, and tested by individual programmers working independently of one another.

This latter objective is achieved by using program subroutines, or subprograms. A program subroutine is a program just like any other program, except that it is not executable by itself; it can only be executed under control of another program. It should be clear, however, that with or without the use of program subroutines, the COBOL programmer can create modular, well-structured programs.

```
Begin Main Program Module
Instruction 1
●
●
●
Instruction M
PERFORM Module A
PERFORM Module B
●
●
●
Instruction n
End Main Program Module
Begin Module A
Instruction 1
PERFORM Module X
●
●
●
Instruction n
End Module A

Begin Module B
 Instruction 1
 ●
 ●
 ●
 Instruction n
End Module B

Begin Module X
 Instruction 1
 ●
 ●
 ●
 Instruction n
End Module X
```

Fig. 6: A general outline of structured programming logic.

The advantage of modular programming depends on how effectively the modules are designed. Each module must be designed to accomplish a distinct function. This gives the program a rather high modification potential. For example, in a pay-roll program there may be a module that calculates the dearness allowance from the basic pay using certain rules. If these rules get changed on a later date, the modification will be limited to the said module and/or to its subordinate modules, if any. It has been seen that it is easier to replace a module by a modified one than to make corrections in one particular part of a conventional program without upsetting the functions of the other parts.

Top-down approach

The above description of modular programming presupposes a hierarchical structuring of modules. The process of designing a program consisting of a hierarchical structure of modules can be viewed in two ways: top-down, and bottom-up.

The top-down approach towards program design starts with the specification of the function to be performed by a program and then breaks it down into progressively subsidiary functions. The division of the function progresses with increasing levels of details. Each function at each level is ultimately realised in the form of a module.

In this approach, the calling module is always designed before the called module. At the time of designing a module, the broad functions to be performed by its immediate subordinate modules are assumed. The details of how a subordinate module can perform the specified functions are not considered until the subordinate module is taken up for design. Thus, the top-down approach represents a successive refinement of functions and this process of refinement is continued until the lowest modules can be designed without further analysis.

The top-down structure can be viewed as a tree structure, a typical example of which is shown in Fig. 7. Each box in this figure is a module. The topmost module denoted by 1 represents the program which can be called as main-line module or main-control module. In this case, the main-control module is divided into three subordinate modules denoted by 2, 3 and 4. The modules 2 and 4 require further divisions and in this process, the terminal modules are 5, 6, 7 and 8. The functions of these terminal modules are assumed to be simple enough to be easily programmed in the source language.

The bottom-up approach is the reverse of the top-down one. The process starts with the identification of a set of modules which are either available or to be constructed. An attempt is made to combine the modules to form modules of a higher level. This process of combining modules is continued until the program is realised. The basic drawback of the bottom-up approach is the assumption that the lowest level modules can be completely specified beforehand, which in reality is seldom possible. Thus in the bottom-up approach, quite often it is found that the final program obtained by combining the predetermined lowest level

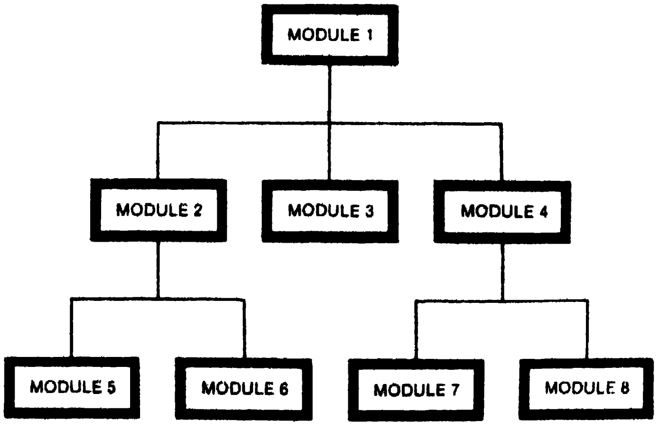

Fig. 7: A typical top-down structure.

modules does not meet all the requirements of the desired program.

No attempt is made here to compare the advantages and disadvantages of the two approaches. However, program development through top-down approach is widely accepted to be better than the bottom-up approach. The top-down approach has the following advantages:

1. It imitates the human tendency to solve a problem by outlining the broad concepts first and then subsequently going into the details.

2. The details of a module can be worked out with no (or minimum) change of the previously outlined concepts regarding its functions

3. The programmer never loses sight of the assumptions made at the previous levels. The development of modules can take place in parallel.

These advantages suggest that if the top-down approach is taken for program design, the programs can be developed easily and quickly, committing minimum of errors.

Constrained use of GO TO

The proponents of structured programming appear to be divided on the question of using the GO TO statement in structured programs. While some recommend the total avoidance of GO TOs in structured programs, others favour its constrained use. Without entering into this controversy, it may be stated that the GO TO statements need not be avoided just for the sake of avoiding them. Only when their use requires a compromise with the readability of the program, must they be eliminated.

Some general rules for the constrained use of GO TOs in COBOL programs are given below (It may be noted that each rule is more restrictive than the preceeding one.):

1. Use GO TO to transfer the control within a module without crossing its boundaries. In other words, a short-range GO TO statement whose object is either the name of the paragraph in which it appears or the name of any other paragraph in a series of paragraphs that constitutes a module is allowed according to this rule.

2. Use GO TO to transfer the control in the forward direction within a module This rule is more restrictive than the previous one as it does not allow the use of the statement to transfer the control in the backward direction.

3. Use GO TO to transfer the control to the exit paragraph of a series of paragraphs constituting a module.

It is worthwhile to note that these rules ensure a localised flow of control so that the readability of the module is not likely to be seriously affected. Moreover, the module as a whole can still be viewed to have a single entry and single exit.

Programming considerations

How do the concepts of structured programming produce better programs? If we take the division of a problem into its programming solution, we see that the programming solution must contain a structure of 'boxes within boxes' in a pictorial representation where boxes within boxes represent the lower level elaboration at the upper level (Fig. 8). This means that we have a modular structure where modules can be tested independently.

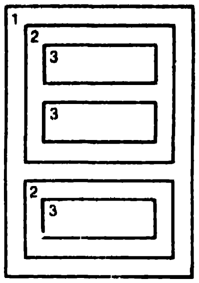

Fig. 8: Block structures (numbers represent the levels).

It should be pointed out here that we have a structure which looks, in some respects, similar to a flowchart which gives a pictorial representation of the program structure. The main difference is that the concepts in structured programming place restraints on the equivalent flowchart representation. The shortcomings of flowcharts are that they are too general and do not constrain the structure to be "well-formed". The main problem is the undisciplined use of the GO TO or JUMP instructions which may cause convoluted flowcharts. Here structured flowcharts may be used to good advantage.

Structured flowcharts

Traditionally, flowcharts have been used for two main purposes: to help the programmer develop the program logic, and to serve as documentation for a completed program. In recent years there has been some tendency to minimise the need or even the usefulness of flowcharts. A case can be made that if a programmer utilises principles of good program structure, the program is self-documenting and therefore a flowchart is superfluous. Further, there are those who argue that in an environment where program modifica-

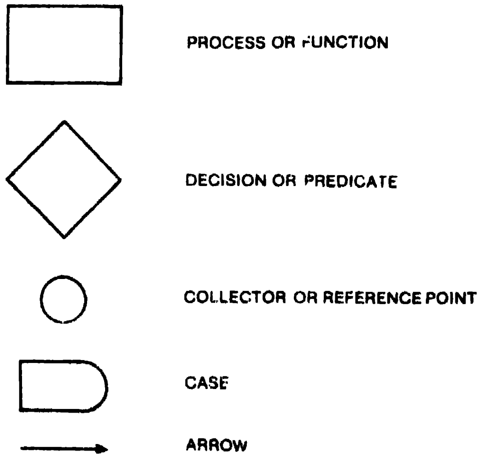

Fig. 9: IBM structured program flowcharting symbols.

tions are frequent, redrawing flowcharts becomes cumbersome. Instead of subscribing to the extreme view that flowcharts are useless, flowcharting can be viewed as a very useful tool for program development and documentation. But this programming aid should not be indiscriminately used.

Structured flowcharts are intended to focus on the program logic rather than on the specific tasks to be performed by the program. As such, structured flowcharts tend to do away with special symbols for input/output, and the like. While there is no standard set of symbols, Fig. 9 presents a set of flowcharting symbols adopted by IBM. A complete flowchart can be drawn using these symbols alone, although one may use standard flowcharting symbols as well. In any case, a structured flowchart is clear, simple and easy to understand. It has one clear beginning and one clear end and the advantage of utilising the five basic structures (SEQUENCE, IFTHENELSE, DOWHILE, DOUNTIL, and CASE).

Structured programming is a good approach for writing correct programs. The strategy behind this technique is: when the foe is formidable, divide and conquer. Such a disciplined approach to programming tends to minimise errors and maximise output, which is the concern of all good programmers.

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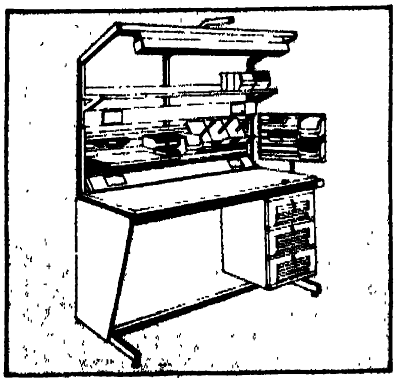

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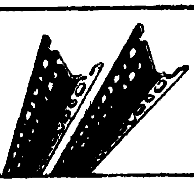

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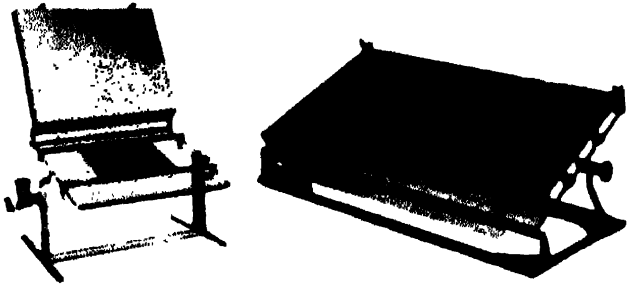

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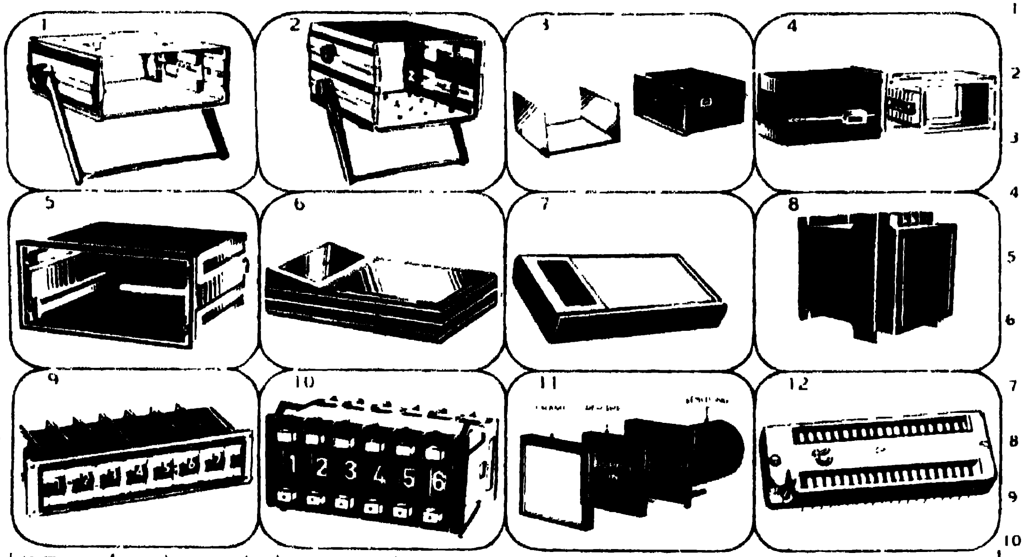

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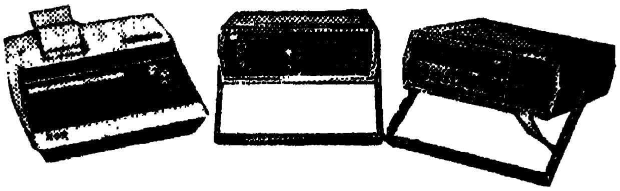

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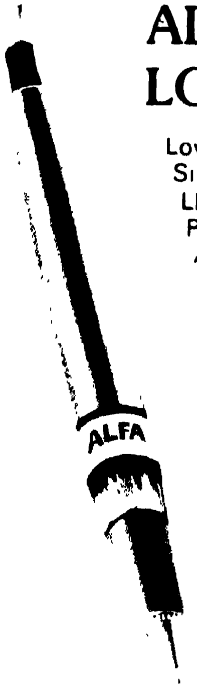

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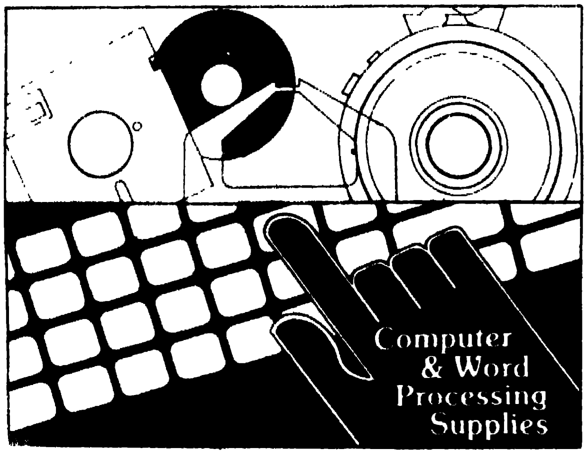

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Crossover Networks

Part II

Jasvinder Osan

The coil former may be made out of the nearest size of PVC conduit pipe, or a wooden cylinder. The sides of the former are made from two pieces of plywood held tightly against the edge by a nut and bolt through the centre as shown in Fig. 11. The coil may be hand or machine wound on this. Preferably, the coil should be layer wound. If not, care should be taken to ensure that all space is filled up. After winding, a diluted epoxy adhesive (like araldite) may be applied to the coil to help it maintain its shape and the former can be slipped off, after loosening the sides. Insulation tape is tied round the coil to prevent the outer ends from opening up. Before winding, the number of turns required can be calculated using the formula given below:

$$n^2 = \frac{L \times 10^9}{24.5a}$$

where n is the number of turns, L is the inductance required in Henry, and a is the length of winding in cm equal to radius of the former.

It may be noted that the winding section is square and is equal to half the diameter of the former, a, i.e. the length of the former is equal to the thickness of the winding and is equal approximately to a. Following the above directions, fairly accurate coils can be wound. If desired, the inductance of the coils may be checked by setting up a simple AC bridge such as the Owens bridge. The circuit for this is shown in Fig. 12. Here, L is the inductance which is to be checked. The balance of the bridge is independent of frequency. The sensing device should most suitably be a CRO. In the absence of this, an AC millivoltmeter, a sensitive AVO meter or even a loudspeaker can serve the purpose. Here, VR is a wirewound potentiometer. Capacitors C1 and C2 are fixed and of any values between 0.1 μF and 0.47 μF normally serve the purpose. R1 and R2 are fixed resistances, where R2 should satisfy the following equation:

$$R2 = (C1/C2)\,R1 \qquad ....5$$

The balance point of the bridge is obtained by carefully adjusting VR till the voltage across the arms A and B is minimum. The inductance is then given by:

$$L = R1.\ VR.\ C1 \text{ (in mH)} \qquad ....6$$

The balance point appears as a sharp dip, and not a gradual decrease. If this eludes you, then first check all connections, and then the fixed value components. Substitute an approximate estimated value for the inductance, and work backwards to get suitable component values for the fixed value components, using equations 5 and 6.

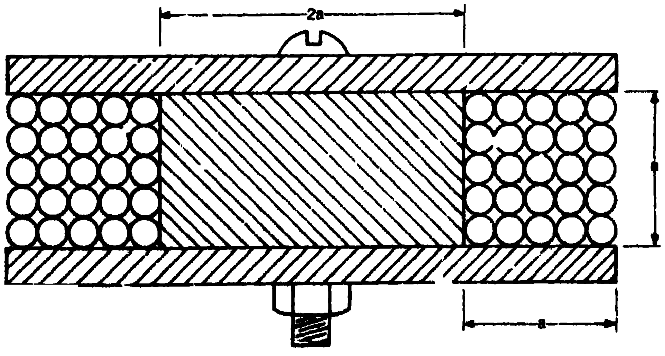


Fig. 11: Schematic showing the construction of a t'pical former for an air-cored coil.

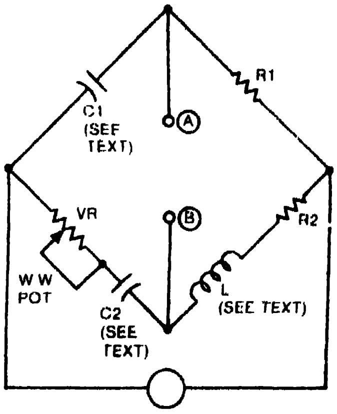


Fig. 12: Typical setup to check the inductance of coil by using the Owen bridge network.

Phasing of loudspeakers

The introduction of any reactive element usually causes a phase shift of the output, with respect to the input. The same can therefore be expected in any crossover circuit. The relative phase of the constituent loudspeakers ultimately affects the frequency response of the speaker system. The polarity of any loudspeaker is usually indicated by the manufacturer by means of a red dot, or some other marking on the appropriate terminal. This can be checked very easily The positive terminal is the one to which the application of a positive voltage causes the cone to move forwards (or outwards). The reverse, obviously causes it to move backwards. Care must be taken, howevei, to ensure that the voltage is just sufficient to move the cone, not blow it across the room.

A first order network, with a slope rate of 6 dB/octave, has desirable characteristics. It is simple to construct and has constant voltage and power transfer as well as a zero phase shift in the output across the entire band. From all angles therefore, the first order network is apparently the most preferable.

The relatively slow rate of attenuation, however, poses a problem. When a first order network is proposed, the component loudspeakers must overlap in their frequency ranges over a four-octave range. That is, the woofer under consideration should have a usable frequency response extending up to two octaves above the crossover frequency, and the tweeter should have a frequency response extending to two octaves below the crossover frequency.

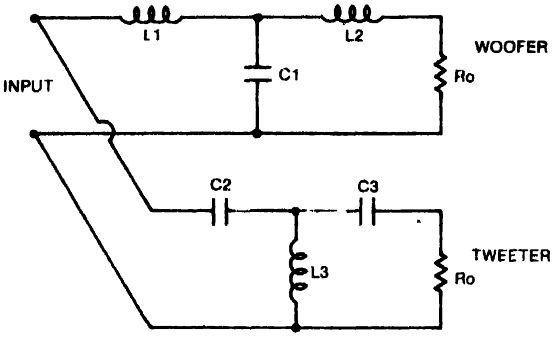
This is a condition which is satisfied by very few units. A consequence of this constraint is an audible harshness of the sound, particularly in the region of the crossover. A first order network would therefore not be recommended for a two-way system. This condition can be fulfilled in case a three-way system is envisaged. That is, it is possible to have a woofer and a midrange which could overlap in a frequency band over the four-octave range. Similarly, we can have a midrange and a tweeter overlapping over a four-octave range. A suitable first order system network can therefore be designed for a three-way system, taking these factors into consideration.

A second order network with a slope rate of 12 dB/octave provides increased attenuation, and thereby decreases the region of overlap in frequency response required between two drivers. The second order network, however suffers from one very serious drawback. At the crossover frequency, the outputs from the respective arms are 180° out of phase with respect to one another. This leads to a 'null' in the output in this region and is audible as a 'hole' or a 'void' in the response of the system.

The most common solution adopted is to simply reverse the polarity in one of the loudspeakers in the system. This is actually a compromise because the 'hole' gets replaced by a 'hump' as a result of the extraordinary phase characteristic which is produced. This method is preferred because the ears are more sensitive to changes in level rather than phase shifts. Also, a 'hump' is always preferred to a 'hole' in the response of the system. In spite of the above deficiency, the second order network remains the most popular network in commercial use.

The third order alternative

L.M. Henne has successfully demonstrated that a third order network with an attenuation rate of 18 dB/octave has a constant voltage as well as power transfer, with a gradual change in phase across the entire band. This gradual phase change is, of course, inaudible. The third order network is therefore a 'no compromise' solution which provides a rapid roll-off rate as well as desirable phase characteristics. The third order network is strongly recommended for use in a two-way system where a good degree of overlap in frequency response in the constituent drivers is not available for a first order network to be used, and when the decrease in sound quality caused by the hump or hole in the second order network is to be avoided. Computer-generated values for the third order networks with 8-ohm drivers for various crossover frequencies are given in Table I. The design equations and the general two-way circuit arrangement is given in Fig. 13.



Design Equations

Low Pass Section

$$L1 = \frac{3R_o}{4\pi f_c}$$

$$L2 = \frac{R_o}{4\pi f_c}$$

$$C1 = \frac{2}{3\pi f_c R_o}$$

High Pass Section

$$C2 = \frac{1}{3\pi f_c R_o}$$

$$C3 = \frac{1}{\pi f_c R_o}$$

$$L3 = \frac{3R_o}{8\pi f_c}$$

Fig. 13: The third order Butterworth filters as an 18 dB/octave constant-resistance frequency dividing network.

TABLE I
Element values for third order Butterworth filters with 8-ohm drivers

fc (Hz)	L1 (mH)	L2 (mH)	C1 (µF)	C2 (µF)	C3 (µF)	L3 (mH)
100.00	19.10	6 37	265 26	132.63	397.89	9.55
125.89	15.17	5.06	210.70	105.35	316.05	7.59
158.49	12.05	4.02	167 37	83.68	251.05	6.03
199.53	9.57	3.19	132.94	66.47	199.42	4.79
251.19	7.60	2.53	105.60	52.80	158.40	3.80
316.23	6.04	2.01	83.88	41 94	125.82	3.02
398.11	4.80	1.60	66.63	33.31	99.94	2.40
501.19	3.81	1.27	52.93	24.46	79.39	1.91
630.96	3.03	1.01	42.04	21.02	63.06	1.51
794.33	2.40	.80	33.39	16.70	50.09	1.20
1000.00	1.91	.64	26.53	13.26	39.79	.95
1258.93	1.52	.51	21.07	10.54	31.61	.76
1584.89	1.21	.40	16.74	8.37	25.10	.60
1995.26	.96	.32	13.29	6.65	19.94	.48
2511.89	.76	.25	10.56	5.28	15.84	.38
3162.28	.60	.20	8.39	4 19	12.58	.30
3981.07	.48	.16	6.66	3.33	9.99	.24
5011.87	.38	.30	5.29	2.65	7.94	19
6309.57	.30	.10	4.20	2.10	6.31	.15
7943.28	.24	.08	3.34	1.67	5.01	.12
10000.00	.19	.06	2.65	1.33	3.98	.10

The quasi-second order network

The third order filter discussed above is both expensive and complicated. Very few readers would, I am sure venture into its construction! The most elegant crossover arrangement—the quasi-second order network—however, is extremely simple and meets almost all requirements. The quasi-second order network is due to A.L. Kaminsky, and is basically the series first order network and is designed according to a modified Butterworth filter characteristic with a response which is unusual, but very desirable.

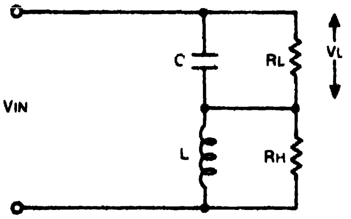


Fig. 14: A simple quasi-second order crossover network.

The circuit of the quasi-second order network is shown in Fig. 14. The computer-generated element values of this network with 8-ohm terminations are listed in Table II.

TABLE II
Computer-generated element values for quasi-second order network

Fc (Hz)	L (mH)	C (μF)
100.00	6.37	397.89
125.89	5.06	316.05
158.49	4.02	251.05
199.53	3.19	199.42
251.19	2.53	158.40
316.23	2.01	125.82
398.11	1.60	99.94
501.19	1.27	79.39
630.96	1.01	63.06
794.33	.80	50.09
1000.00	.64	39.79
1258.93	.51	31.61
1584.89	.40	25.10
1995.26	.32	19.94
2511.89	.25	15.84
3162.28	.20	12.58
3981.07	.16	9.99
5011.87	.13	7.94
6309.57	.10	6.31
7943.28	.08	5.01
10000.00	.06	3.98

[1] Reproduced from the Journal of Audio Engineering Society, Vol. 19, June 1971.

The low frequency channel cuts off at 12dB/octave at the crossover frequency and at 6 dB/octave above twice the crossover frequency. Likewise, the high frequency channel also cuts off at 12 dB/octave at the crossover frequency and then at 6 dB/octave—an octave below the crossover frequency. Hence the name quasi-second order for this class of filters. The quasi-second order filter has all the advantages of the first order networks, with constant voltage and power transfer and minimum phase difference in the outputs. In addition to being simple and having half the components of a conventional second order filter, the quasi-second order filter is not affected by minor component tolerances, as an error in the crossover point effects both the HF and LF sections in a complementary manner.

The two-way crossover as described can easily be extended to three-way or even four-way networks by cascading two or more networks, taking the HF output as the input for the second network. The three-way arrangement is shown in Fig. 15. If f1 and f2 are the two crossover frequencies for the three-way system, then L1 and C1 are found by using f1, and L2 and C2 are found by using f2 in Table II.

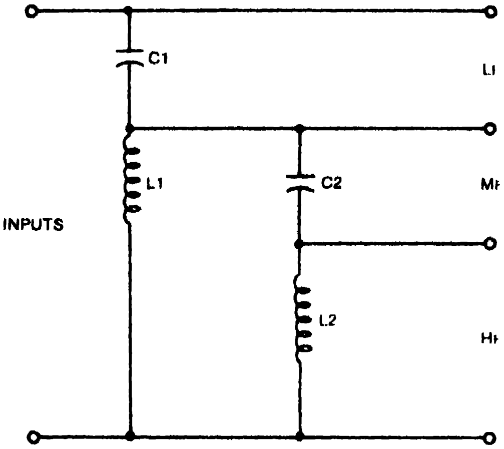


Fig. 15: A three-way crossover series network.

The design of a crossover network cannot be considered independently of the drivers of the system. The component loudspeakers should be compatible with each other, with similar sensitivities and frequency responses overlapping over a two to four octave range.

No particular crossover design can be generalised for use with all loudspeaker systems since the characteristics of the individual loudspeakers determine the crossover frequency and the attenuation rates required.

So, for any system, the simplest crossover design performing the desired function appropriately, may be considered as the ideal one. The first order crossover network has zero phase shift in the output and constant power and voltage transfer. But its slow attenuation rate makes it necessary for the loudspeakers in use to overlap in the frequency range over four octaves.

The second order network has an attenuation rate of 12 dB/octave and is commercially the most popular. The phase shift introduced by this network, however, adversely affects the frequency response of the system.

The third order network has a steep attenuation rate (18 dB/octave) and thereby permits the use of loudspeakers having minimal overlap in the frequency ranges. It also has acceptable phase characteristics and is best in performance though being more complicated.

The quasi-second network is by far the best in terms of simplicity and in providing a fast roll-off and zero phase shift, while maintaining constant voltage characteristics. □

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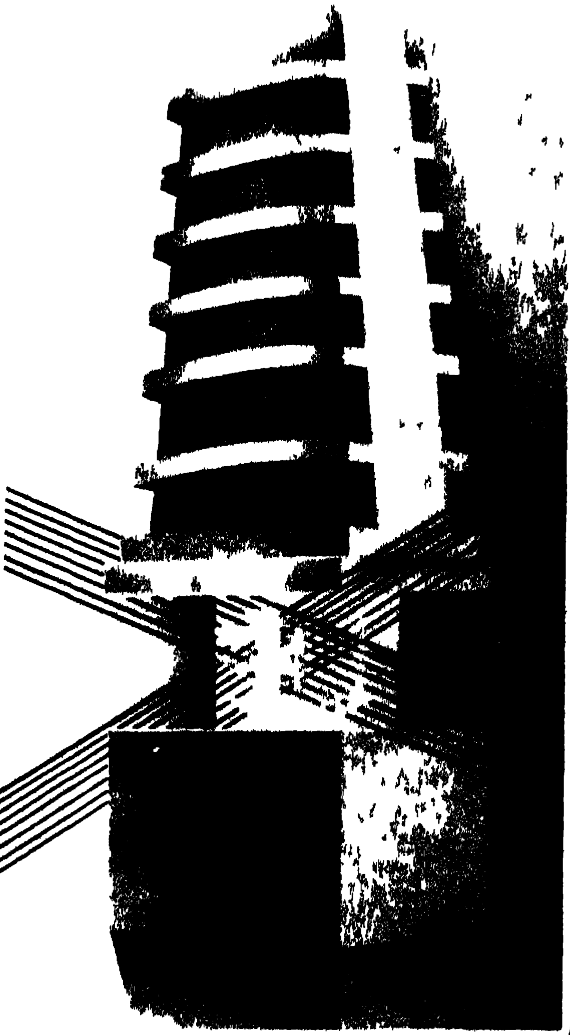

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Mev	**0 4-1 0**	**0 8-1 5**	**0 5-0 7**	**1 0-1 5**	**1 2**	**0 5-2 0**
kW	**20**	**20**	**50**	**50**	**100**	**20**

	ILU-7	ILU-8
MeV	**2 0-3 0**	**0 5-0 8**
kW	**50**	**20**

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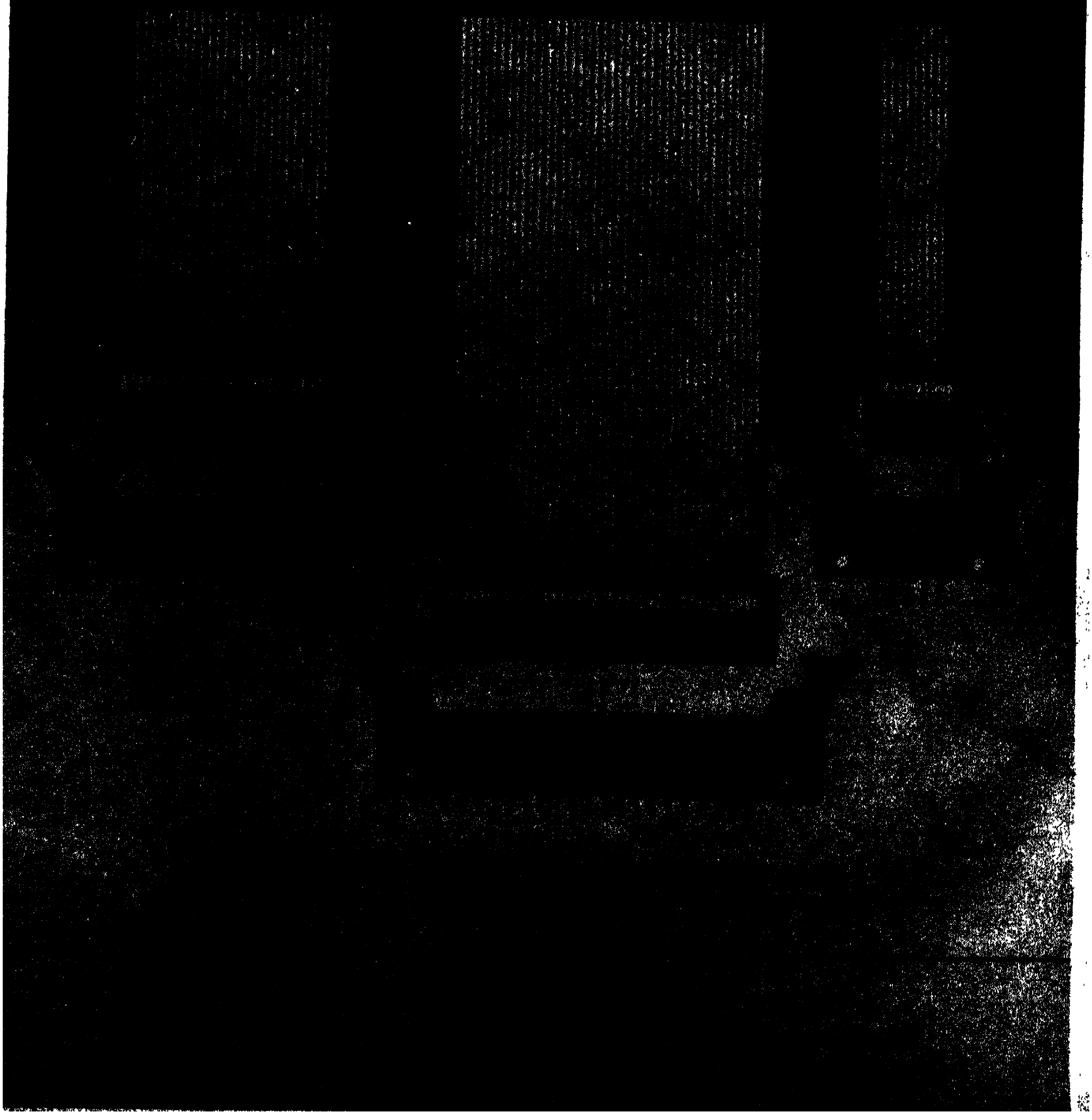

Automatic Tank Filling Cum Pump House System

Y.M. Rama Rao, A.S. Sreenivasan and
A.K. Raveendran

Here is a simple circuit which can be used for controlling the water level in both the single tank or the combined overhead/sump tank systems automatically. It switches on the motor pump when the water level in the overhead tank falls to a pre-set minimum level (P1) and switches off the pump when the water level reaches the maximum pre-set level (P2) in the overhead tank It automatically switches off the motor when the sump runs dry or the motor fails or the pump is unable to pump the water from the sump This unit gives one visible indication for motor running and another indication for pump failure (or dried up sump) for attending to its failure.

This unit can be powered from the domestic AC mains and consumes very little power A 4-core cable (three for probes and one for earth wire), is to be drawn from the unit to the overhead tank Two CMOS CD4011 ICs (quad 2-input NAND gates) are used

Circuit details

[illegible]ose who want the motor to switch 'on' or 'off' on the

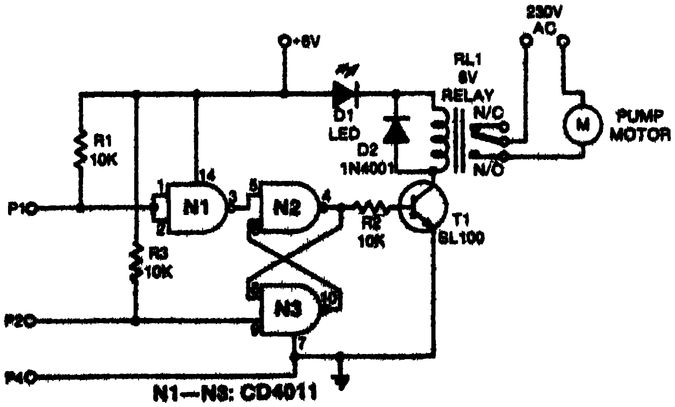

Fig. 1: Simple automatic tank filling system.

PARTS LIST

Semiconductors:	
IC1	— CD4011 2-input quad NAND gate
T1	— SL100 npn transistor
D1	— 5mm light-emitting diode
D2	— 1N4001 rectifier diode
Resistors:	
R1-R3	— 10-kilohm, ¼-watt carbon
Miscellaneous:	
RL1	— 6 volt, 300-ohm relay
	— General-purpose board, flexible wire, brass rods, rod connectors, LED holders, enclosure etc.

[illegible]ors work as telecommunication inspectors in the Microwave [illegible], Secunderabad

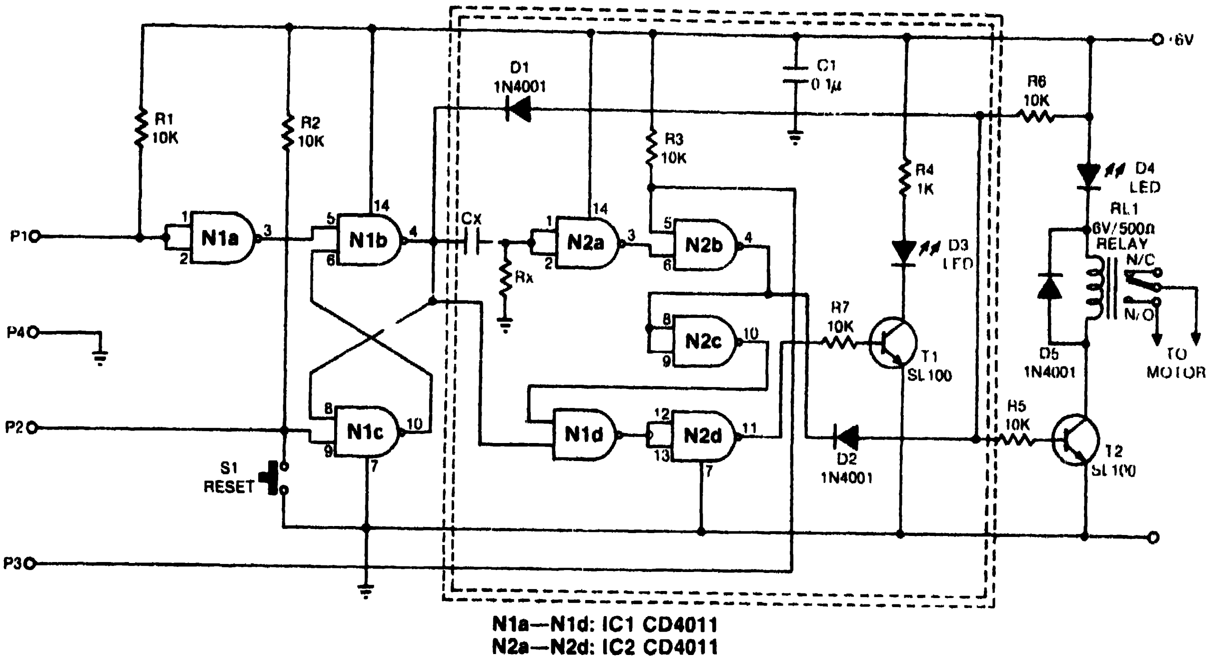

Fig. 2: Automatic tank filling system with pump failure indication.

PARTS LIST

Semiconductors:	
IC1, IC2	CD4011 2-input quad NAND gate
T1, T2	SL100 npn transistor
D1, D2	1N4001 rectifier diode
D3, D4	5mm light-emitting diode
Resistors:	
R1-R7	10-kilohm, ¼-watt carbon
Rx	See text
Capacitors:	
C1	0.1μF ceramic disc
Cx	See text
Miscellaneous:	
RL1	6-volt, 500-ohm SPDT relay General-purpose board, brass rods, rod connectors, flexible wire, LED holders, enclosure etc.

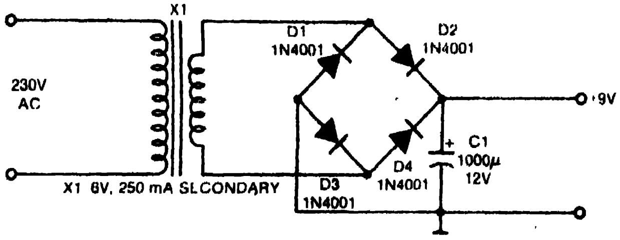

Fig. 3: Power supply for the circuit.

PARTS LIST

Semiconductors:	
D1-D4	1N4001 rectifier diode
Capacitor:	
C1	100μF, 12V electrolytic
Miscellaneous:	
X1	6V, 250mA transformer Flexible wire, mains cord, strip board, battery connectors, metal enclosure etc.

basis of the water level in the overhead tank irrespective of the water level condition in the sump or whether the pump is able to suck the water from the sump or not, the circuit given in Fig. 1 is sufficient. When the water level in the overhead tank goes below probe P1, P1 becomes 'high' making the output of gate N1a low, which in turn makes the output of gate N2 (flip-flop) high. This sequence enables the transistor to conduct and operate the relay. The relay operation extends supply to the motor and water starts filling in the tank. As soon as the water touches probe P2, P2 becomes 'low'. This resets the flip-flop which de-energises the relay and stops the motor. It remains in the same state till the water level goes below P1.

For those who want to stop the motor if there is no water in the sump or the pump is not able to pump the water up, and want to get an indication or alarm to attend to the failure, the circuit given in Fig. 2 will be useful. Only the circuit in the dotted portion is the improvement on the earlier circuit and hence the working of the circuit outside the dotted portion is same as before. The output of gate N1b, in addition to driving the motor also triggers the monostable. The period ($T = 1.4 R_x C_x$ sec) of the monostable is set according to the time taken by the pump to start filling the tank, once the supply to the motor is 'on'. If the period is double that time, it is better.

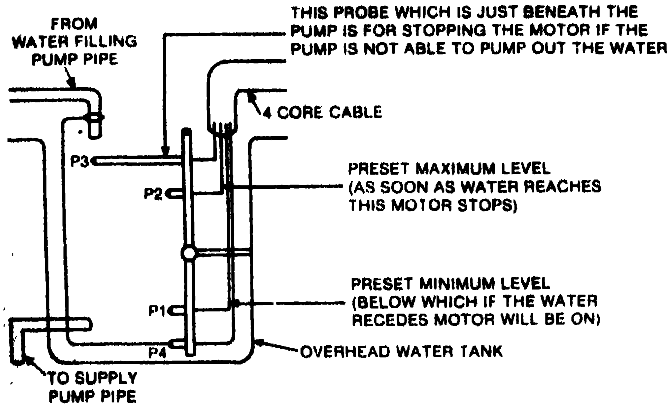
FROM WATER FILLING PUMP PIPE
THIS PROBE WHICH IS JUST BENEATH THE PUMP IS FOR STOPPING THE MOTOR IF THE PUMP IS NOT ABLE TO PUMP OUT THE WATER
4 CORE CABLE
P3
P2
PRESET MAXIMUM LEVEL (AS SOON AS WATER REACHES THIS MOTOR STOPS)
PRESET MINIMUM LEVEL (BELOW WHICH IF THE WATER RECEDES MOTOR WILL BE ON)
P1
P4
OVERHEAD WATER TANK
TO SUPPLY PUMP PIPE

Fig. 4: Internal tank wiring system.

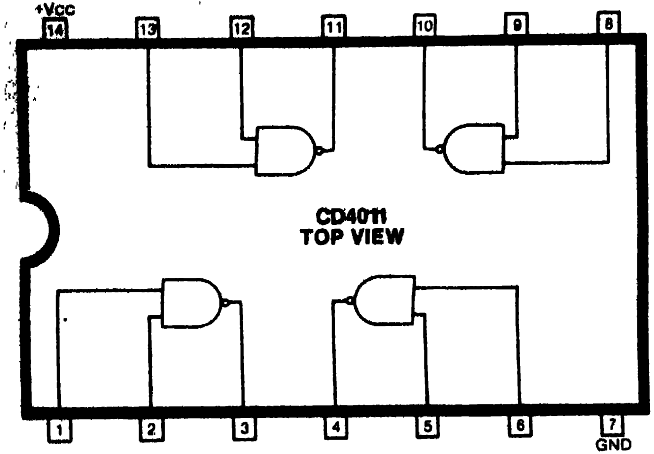

Fig. 5: Pin configuration of IC CD4011.

After this period, the output of the monostable becomes high. Even at that instant, if the water does not come out of the pump because there is no water in the sump or the motor fails, probe P3, which is just beneath the mouth of the filling pump at the overhead tank, remains high, turning the output of gate N2b low and, turns the diode NAND gate low thus turning off the relay and the supply to the motor. The output of gate N2d drives the red LED, indicating this failure. This red LED remains lit and the supply to the motor remains cut as long as the circuit is not reset manually after attending to the failure.

The total cost of the circuit is around Rs 60. This circuit has been tried with good results. A switch can also be provided across the relay contacts which is normally 'off' and can be switched 'on' during an emergency.

Lab Note: To maintain proper sensitivity in the circuit, the gap of the sensor probes (P1-P4) should be maintained at 1.5 mm for unfiltered water coming from the sump. But for filtered water, if the relay operation is not proper, increase the value of R1 and R3 to 1 Meg and use brass type sensing probes. □

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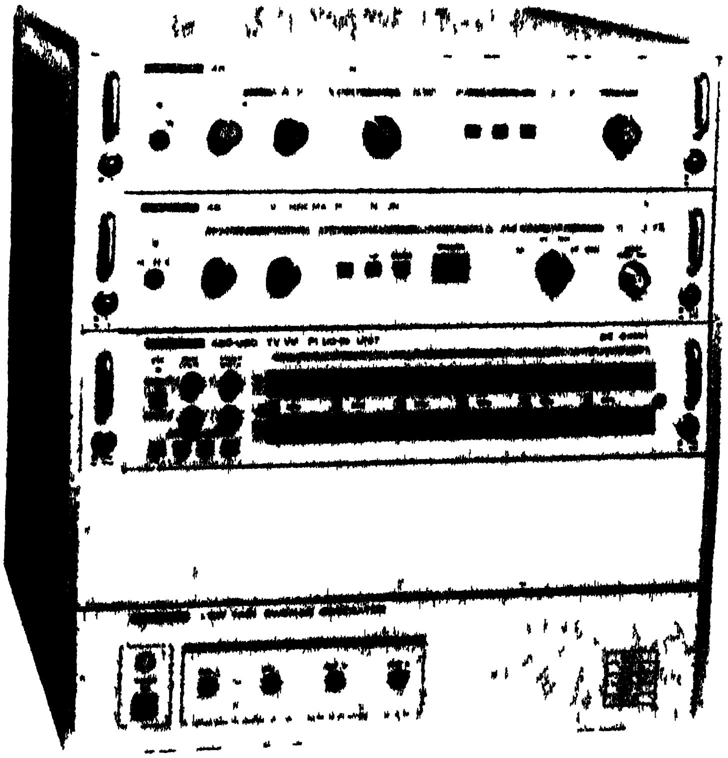

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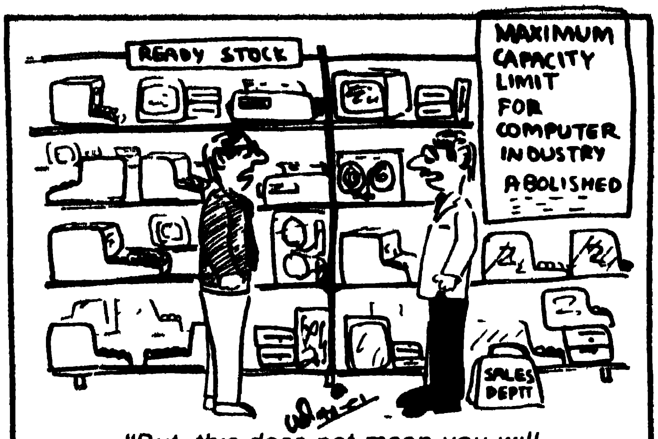
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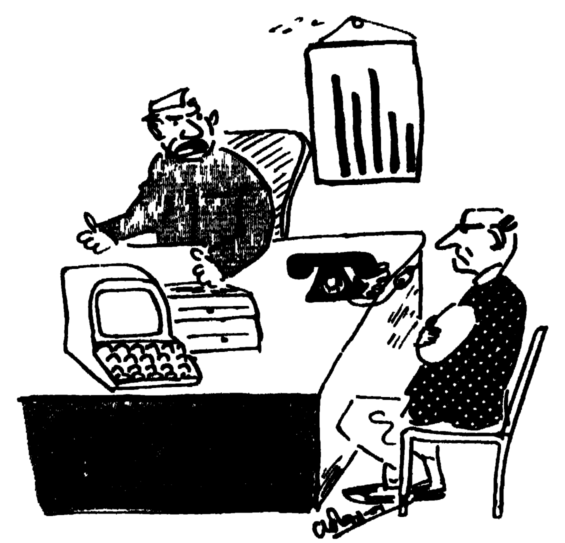

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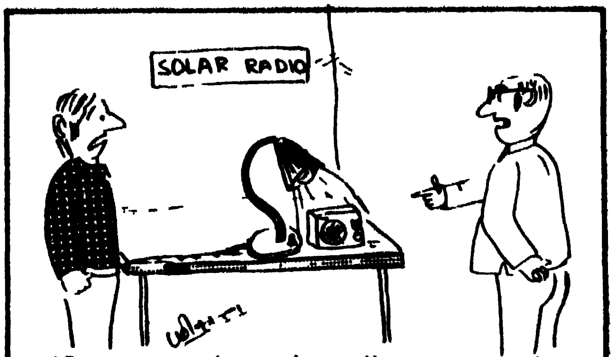

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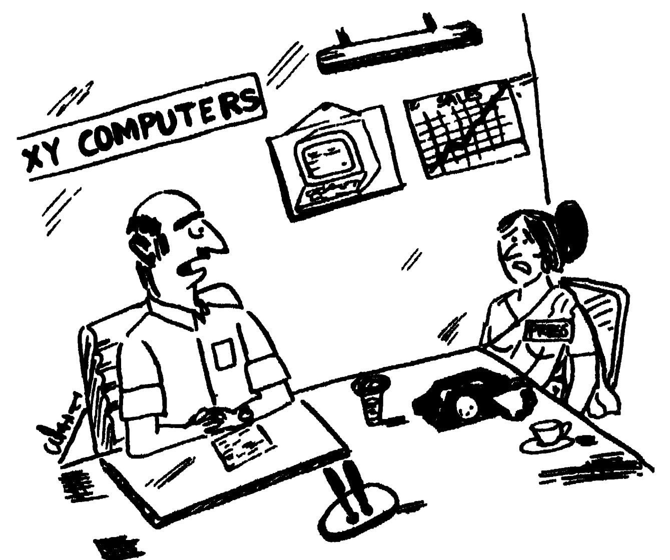

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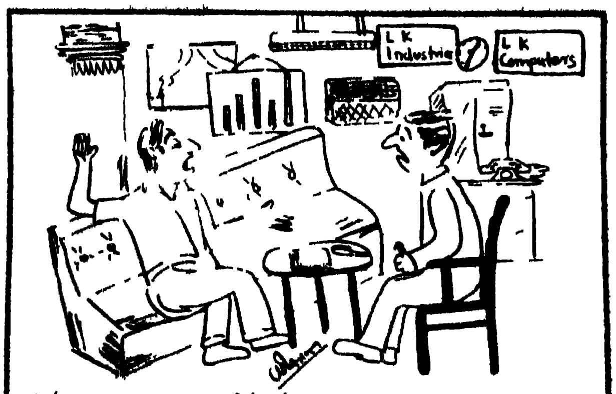

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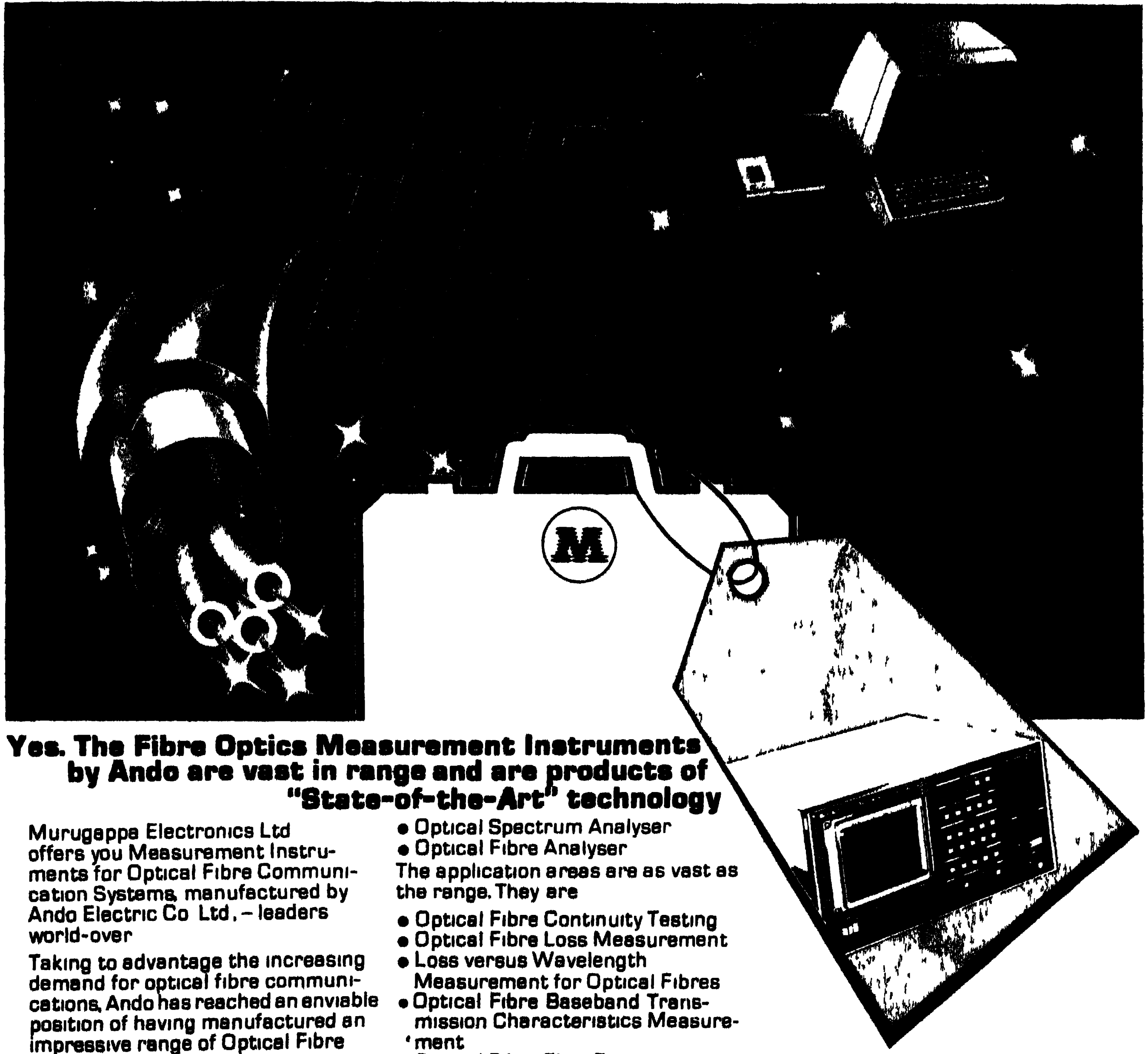
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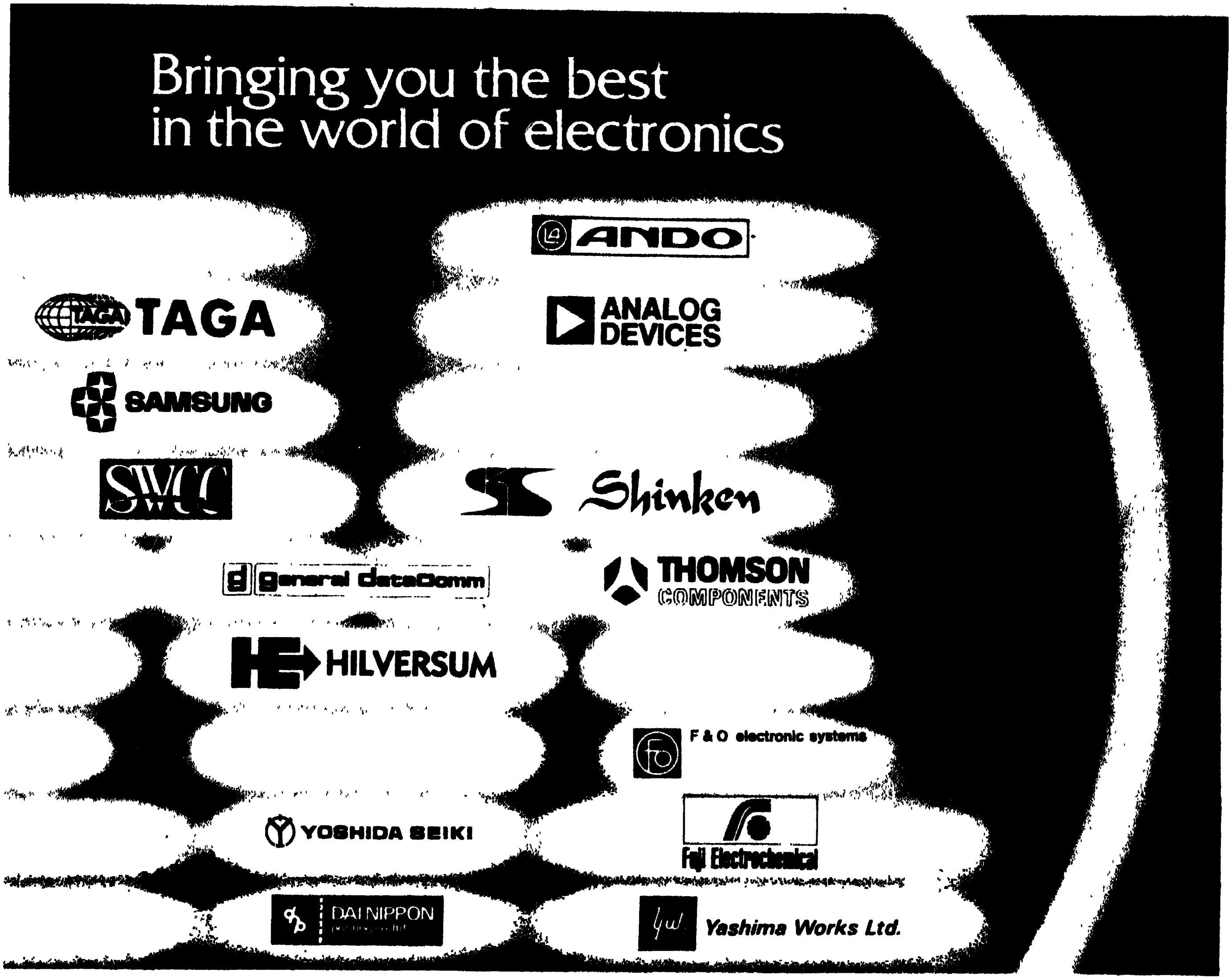

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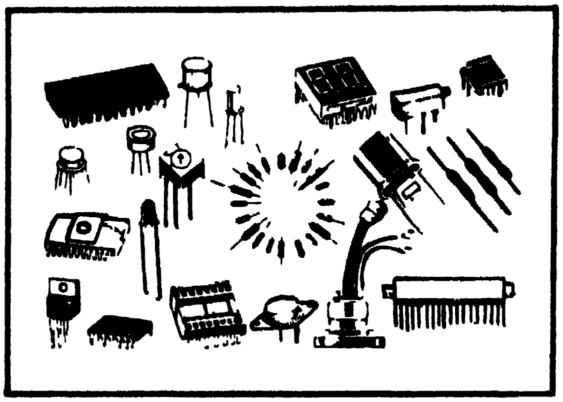

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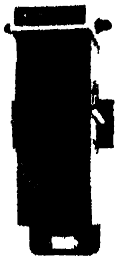

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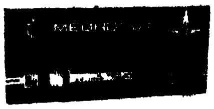

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Radio Cassette Recorder (Two-in-One)

S. Das Gupta

Audio projects are always appreciated and accepted by every electronic enthusiast—from the beginner to the professional In recent times a cassette recorder with a good sensitive radio, called a two-in-one, has proved more popular than a single cassette recorder because of the greater programme selectivity offered to the listener Another advantage of a radio cassette recorder is that it has a facility for direct recording from radio The quality of sound also is better due to its large-diameter speaker and greater inner volume of the cabinet

Today in the local market, a variety of cabinets with deck mechanisms is available at reasonable cost The construction of radio cassette recorder is not an easy task due to the complex mechanical fittings involved but it is not very hard once the construction details are properly understood So carefully read, the entire text before attempting to assemble the circuit

About the circuit

A variety of power amplifier circuits and preamplifier circuits with different specifications and using varieties of ICs and transistors is now available in the market. These are the low-cost types with acceptable performances and have been found suitable for a cassette recorder But, except for a few, these circuits do not give faithful reproduction due to improper network design and low-cost, low-count components. Basically, at supply voltages of say, 6V or 9V, these amplifiers deliver a maximum of 1 watt at frequency responses between 100 Hz to 5 kHz with a 10 per cent total harmonic distortion at maximum output which is unacceptable for a good audio system.

Most of the preamp circuits used in locally available cassette recorders are unable to produce the proper high frequency response. The bass response also gets clipped at 50 per cent volume of sound. Modern cassette recorder circuits use transformerless output stages using ICs and transistors in push-pull configuration and direct-coupled preamplifier stages in contrast to the RC-coupled stages used in the earlier sets, resulting in slight improvement in the overall performance

Keeping all the above points in mind, to get a satisfactory performance a circuit is offered here comprising a capacitor-coupled IC type power amplifier stage using TBA810 IC and direct-coupled preamplifier stage The circuit has a well designed feedback network for better high-frequency and low-frequency responses and passive, bass and treble cut type tone control, effective only at low- and high-frequency responses with an emitter-follower amplifier to maintain the input and output impedance

Specification Chart

General specifications:	
Semiconductors	IC - 1 no Transistors - 8 nos Diodes - 6 nos
Power supply	220V AC (50 Hz) or 6V DC
Speaker	4-ohm, 15cm round
Output power on 4-ohm load	1 25-watt music power (2 5-watt peak power output)
Radio section:	
Circuit system	MW/SW 2-band superhetrodyne
Tuning range	MW-550 kHz to 1600 kHz SW-5 5 MHz to 1 6 MHz
Antenna	Ferrite rod antenna for MW band and telescopic antenna for SW band
Tape recorder section:	
Tape	Cassette tape
Tape speed	4 75 cm/sec
Playback frequency	60 Hz to 12 kHz (±3dB)
Erasing system	DC erase
Recording bias	DC bias
Output impedance	4-ohm
Input sensitivity	Mic 0 7mV, 3 3-kilohm Aux 100mV, 470-kilohm

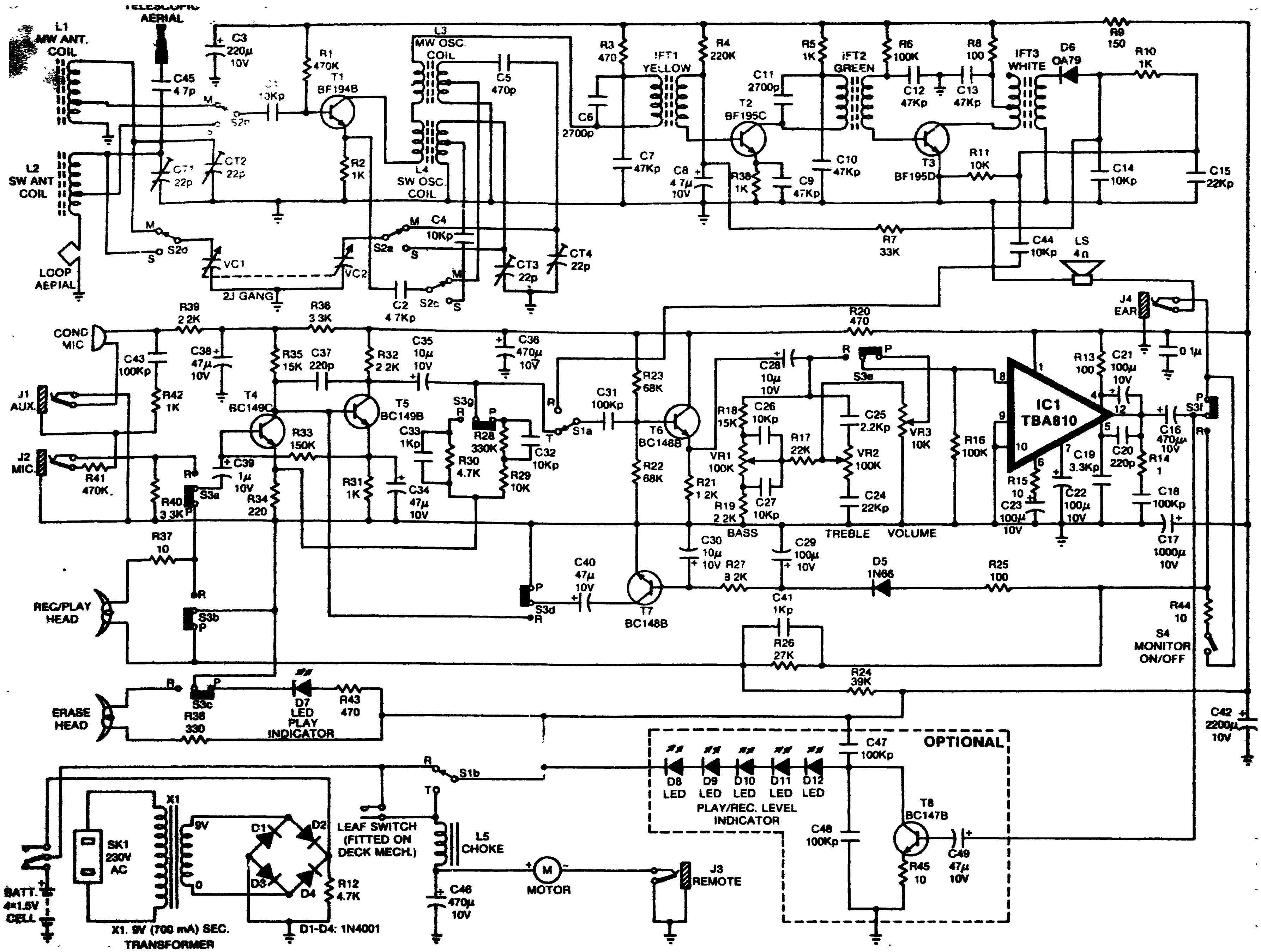


Fig. 1: Circuit diagram for the radio cassette recorder.

PARTS LIST

Semiconductors:

IC1	TBA810, 7-watt power amp.
T1	BF194B npn RF-mixer transistor
T2	BF195C npn RF-IF transistor
T3	BF195D npn RF-IF transistor
T4	BC149C low-noise npn transistor
T5	BC149B low-noise npn transistor
T6, T7	BC148B npn AF transistor
T8	BC147B npn AF transistor
D1-D4	1N4001 rectifier diode
D5	1N66 detector diode
D6	OA79 detector diode
D7-D12	Light-emitting diode.

Resistors (all ¼ watt, ±5% carbon):

R1, R41	470-kilohm
R2, R5, R10, R31, R42	1-kilohm
R3, R20, R43	470-ohm
R4	220-kilohm
R6, R16	100-kilohm
R7	33-kilohm
R8, R13, R25	100-ohm
R9	150-ohm
R11, R29	10-kilohm
R12, R30	4.7-kilohm
R14	1-ohm
R15, R37, R44, R45	10-ohm
R17	22-kilohm
R18, R35	15-kilohm
R19, R32, R39	2.2-kilohm
R21	1.2-kilohm
R22, R23	68-kilohm
R24	39-kilohm
R26	27-kilohm
R27	8.2-kilohm
R28	330-kilohm
R33	150-kilohm
R34	220-ohm
R36, R40	3.3-kilohm
R38	330-ohm
VR1, VR2	100-kilohm, lin. potentiometer
VR3	10-kilohm, log. potentiometer

Capacitors:

C1, C4, C14, C26, C27	10kpF, 160V polyester
C2	4.7kpF ceramic disc
C3	220μF, 10V electrolytic
C5	470pF styroflex
C6, C11	2700pF styroflex
C7, C9, C10, C12, C13	47kpF, 160V polyester
C8	4.7uF, 10V electrolytic
C15, C24	22kpF polyester
C16, C36, C46	470μF, 10V electrolytic
C17	1000μF, 10V electrolytic
C18, C31, C43, C47, C48	100kpF polyester
C19	3.3kpF ceramic disc
C20, C37	220pF, styroflex
C21, C22, C23, C29	100μF, 10V electrolytic
C25	2.2kpF ceramic disc
C28, C30, C35,	10μF, 10V electrolytic
C32, C44	10kpF ceramic disc
C33, C41	1kpF ceramic disc
C34, C38, C39, C40	1μF, 10V electrolytic
C42	2200μF, 10V electrolytic
C45	4.7pF ceramic disc
C49	47μF 10V electrolytic
C11-CT4	22pF button trimmer
VC1, VC2	2J brass type gang

Miscellaneous:

L1-L4	2-band, 2J type silicon coil set
L5	Motor choke
IFT1-IFT3	2700pF type (yellow/green/white) IFT set
SK1	AC socket
X1	9V, 700mA secondary transformer
LS	4-ohm, 15 cm loudspeaker (type Luxco or Quam)
S1	2-pole, 2-way switch
S2	6-pole, 2-way band switch
S3	Tape recording switch
S4	Monitor on/off switch
J1, J2, J4	3.5mm EP jack
J3	2.5mm EP jack
	6.5 cm ferrite rod with holder, telescopic aerial, dial thread, flexible wire, shield wire condenser mic., PCB set, sleeves, deck mechanism with cabinet and fittings, nuts, bolts, washers, spacers etc.

The circuit diagram of the radio cassette recorder is shown in Fig. 1. The overall system is divided into two parts: (i) tape recorder section, and (ii) radio section.

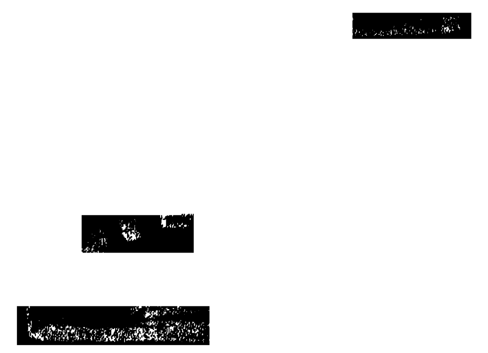
Tape recorder section

As already discussed, varieties of transistors and ICs are available in the market at low cost with high-quality performance. Most of the ICs available in the market are only for power-amp circuits. So, for power amplifier circuits we choose the popular and easily available 12-pin dual-in-line IC TBA810. This IC is very economical compared to the other high-power ICs and is very easy to use as it requires few external components. This IC operates over a very wide voltage range of 6V to 16V. Here, 6V is chosen for circuit operation. The total output power is 1 watt for 4-ohm speaker load without any heatsink.

Positive rails are given to pins 1 and 4 and pins 9 and 10 are grounded. A higher value output capacitor (470μF,10V) is chosen for getting a good low-frequency response and a 1-ohm resistor is grounded via the 0.1μF capacitor from pin 12 of the IC, to provide the high-frequency roll-off appearing inside the IC. A 100μF electrolytic capacitor connected between pins 12 and 4 of the IC, along with a 100-ohm resistor from the supply terminal, provides bootstrapping for the supply with component values recommended in the circuit and has a wide frequency response for the power amplifier (10 Hz to 30 kHz flat). To avoid any instability in the circuit, a 0.1μF ceramic capacitor is connected between the supply pin 1 of the IC and ground. An electrolytic capacitor (100μF) between pin 7 and ground acts as a ripple filter, and a 10-ohm resistor connected to pin 6 of the IC provides the negative feedback and gain of the power amplifier whereas electrolytic capacitor C23 blocks the DC voltage.

The tone control circuit is the most important circuit in cassette recorders. Passive tone control circuits such as frequency cut type, have a low parts count. Though they suffer severe insertion losses, they serve our purpose adequately. Both bass and treble controls are incorporated in the circuit. Bass controls are effective at 100 Hz while treble controls are effective at 10 kHz. An emitter-follower amplifier is also incorporated between the tone control circuitry and preamplifier, to avoid input and output impedance mismatching and to give better frequency responses without any severe loss. The gain of the emitter-follower amplifier is 1 (i.e., unit gain). It has a very high input impedance and low output impedance.

The preamplifier circuit of a cassette recorder plays a very important role in tape recorder technology because the overall performance of the circuit finally depends on the preamplifier characteristics. Improper designing of feedback network causes high-frequency and low-frequency loss leading to very poor performance. This circuit uses a well-known direct-coupled preamplifier with low-noise silicon npn transistors. The direct-coupled transistors (T4 and T5) ensure good frequency response. The first stage has T4 (BC149C) npn silicon transistor which gives high gain and low noise. Base bias for the first transistor T4 is obtained from the second transistor T5 (BC149B), through a 150k resistor (R33) connected between the emitter of T4 and the base of T5. This system of obtaining base bias ensures bias stabilisation called DC feedback. The frequency selective network from collector of T5 via C35 (10μ) to the emitter of T4 is incorporated. This is different for playback and recording because at the time of playback, high-frequency attenuation or bass boosting is necessary while for recording, high-frequency boosting is necessary.



Inside view of the prototype of radio cassette recorder.

In modern cassette recorders, the ALC (automatic level control) circuit has become very popular because of the advantage of eliminating the manual level control. For a good tape recorder, an effective ALC circuit is a must and for this purpose a transistorised ALC circuit has been incorporated. In ALC action, the input voltage of the amplifier increases and decreases in accordance with the power output at a certain level. In other words, the ALC circuit adjusts the gain of the preamplifier in record mode at a predetermined level and ensures that the current through the recording head does not exceed the saturation limit.

For the recording circuit, all types of input facilities are provided. A condenser microphone for external recording and extra auxiliary jack for direct recording are provided. For biasing to recording head, a DC bias is incorporated since in low-voltage mono recording apparatus, DC bias must be adequate for recording. So, in the present circuit, a DC bias along with DC erasing is used to complete the recording chain. A 330-ohm resistor is used to drop the DC supply current for erase head.

Radio section

No discrete spares or complicated technology is used for the two-in-one circuitry to understand the troubleshooting technique.

The basic configuration of the RF circuitry is almost the same as of the circuits used in commercial receivers available in the market. But to attain better signal reception in both MW and SW bands, the prescribed component values here have been kept slightly different from those of the other sets.

The RF stage is developed using the easily available low-cost, high-frequency silicon transistor BF194B which acts as a mixer-cum-RF amplifier. Transistor T1, along with the oscillator coil, forms a high-frequency oscillator and the rate of oscillation can be varied with the help of a gang capacitor. The modulated RF signal picked up by the antenna coil is fed to the base of the mixer transistor BF194B and simultaneously the oscillator signal is coupled to its emitter. After mixing both the signals, an IF signal is obtained from T1 and fed to the IF transformer. IF frequency is the difference between the modulated RF frequency and oscillator frequency which is typically 455 kHz.

A ferrite rod antenna is used for MW band to increase the sensitivity of the pick-up signal. To obtain better selectivity for IF stages, three IF transformers, along with two IF amplifiers comprising BF195C and BF195D, are used in the circuit. The difference signal or IF signal (455 kHz) is fed to the first IF amplifier T2 (BF195C) from the collector of RF amplifier T1 (BF194B) through an IF transformer. After preamplification, the signal is fed to the second IF amplifier for further amplification. The output is then fed to the detector stage and after detection, the AF signal is separated and fed to the AF amplifier for necessary boosting of audio signals at the output end. A bypass capacitor of 10kpF is connected between the anode of detector diode OA79 and ground to bypass the unwanted IF signals. A small amount of negative signal is injected into the base of the first IF amplifier to make the automatic gain control (AGC). IFTs

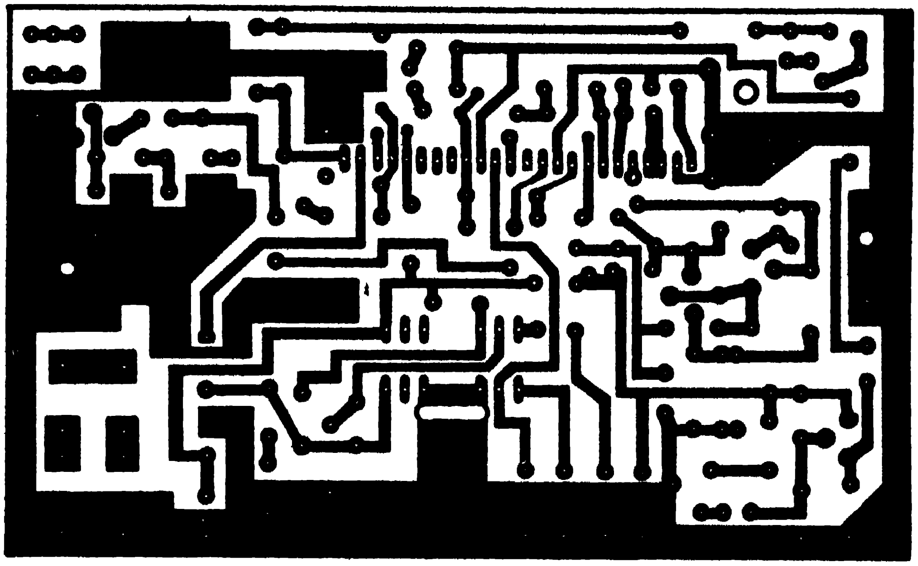


Fig. 2: Actual size PCB layout for the tape recorder section.

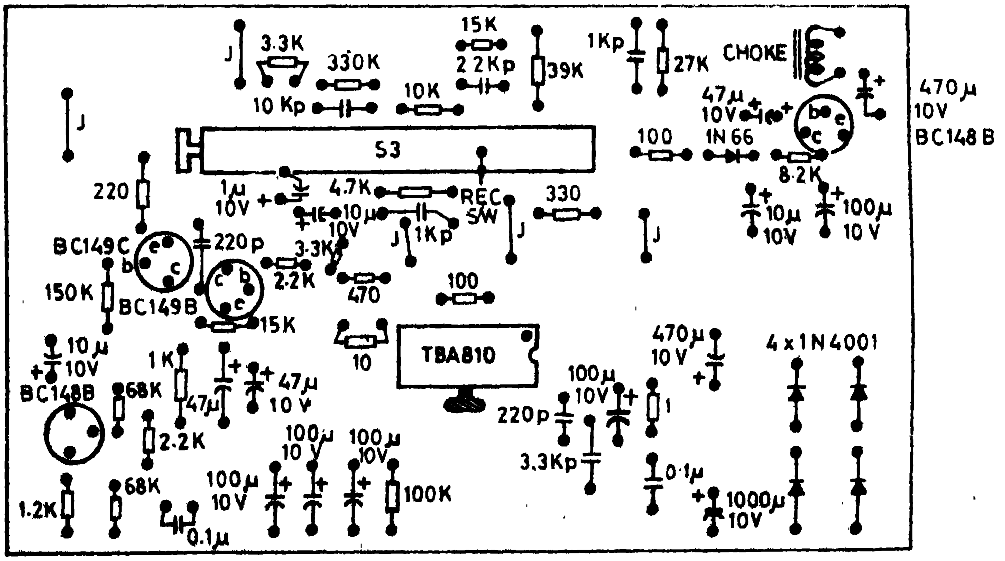


Fig. 3: Components layout for the tape recorder section.

of 2700 pF type (455 kHz) are chosen for better selectivity in SW bands.

General testing

Before testing the equipment, it is advisable to recheck the overall wiring and components placing. Having done so, put the selector switch in 'tape' position and connect the mains cord to AC socket, switch on the mains and check the transformer's secondary DC voltage after rectification with a multimeter. It should be 6V. If the voltage is lower than prescribed, recheck the secondary AC voltage after eliminating the secondary wires from PCB and replace the faulty rectifier diodes after confirming the proper transformer voltage.

Next, push the 'play' button and check the DC voltage in the circuit. It should be 6V on load. Now rotate the volume control fully clockwise and look for the hissing sound from the speaker. Note that the hissing must be neat and flat, without any distortion. Then rotate the treble control clockwise/anticlockwise and confirm whether hissing also increases/decreases along with the rotation of the treble potentiometer. Now adjust the bass potentiometer at maximum and touch the input of preamp and check the humming sound from the speaker. Compare the strength of the hum at maximum and minimum bass control. It should be dull at minimum, strong at maximum.

In case there is no output from the speaker, then: (a) check the continuity of the rec/play switch with a multimeter, (b) check external speaker jack connection and its contacts, (c) touch pin 8 of IC TBA810. If the speaker hums, then fault may be in tone control circuitry or preamp section. Rectify this with voltage measurements, and (d) touch the base of T4

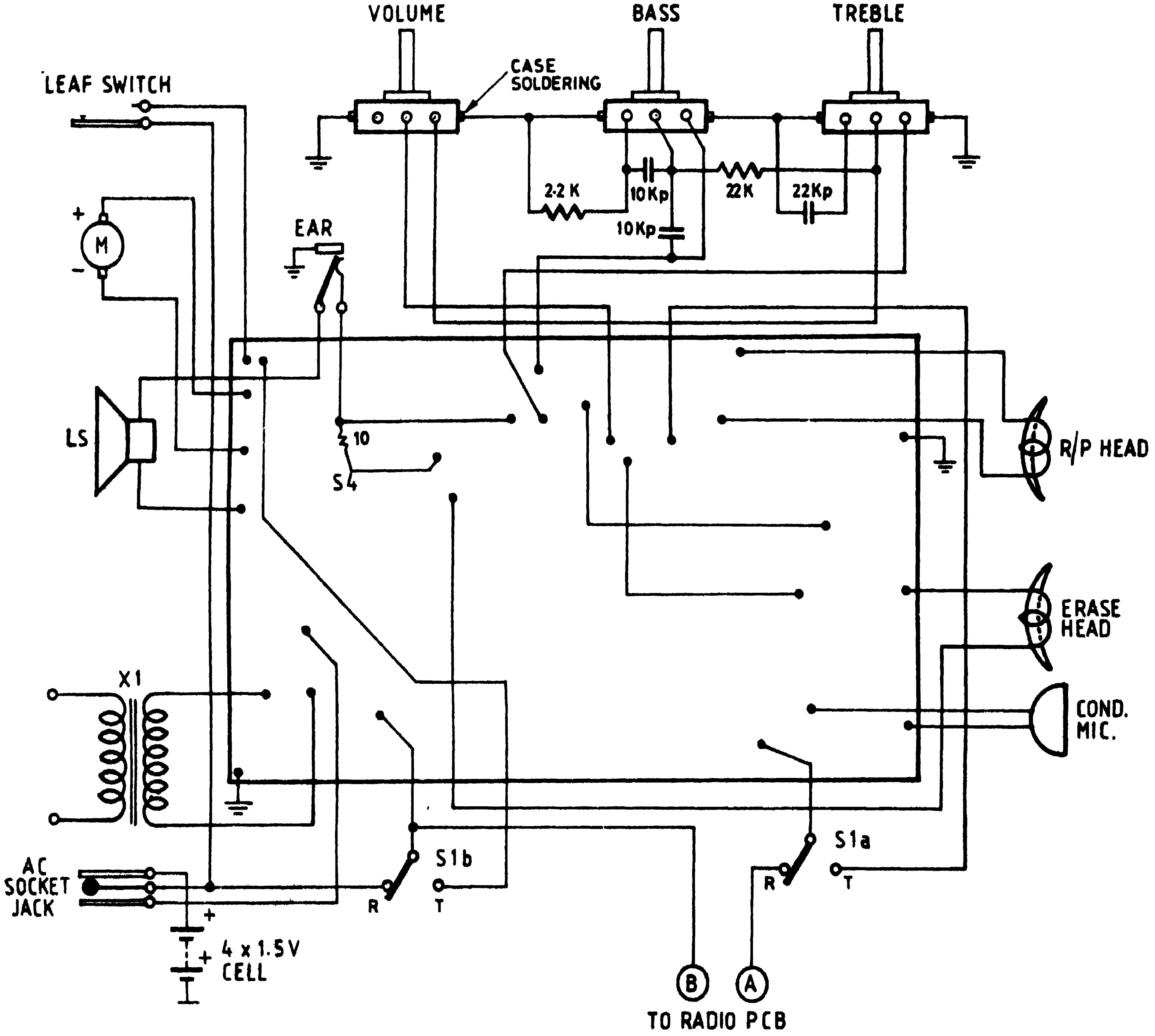


Fig. 4: Chassis wiring layout for the tape recorder section.

BC149C. If the speaker hums, it indicates that the entire circuitry is working properly. But if there is any shorting of rec/play head with ground or the gain of the preamps is too low due to faulty emitter resistor and capacitor connected to T5, replace them with better ones.

If everything is functioning well, insert a good quality cassette and press the play button. Keep the bass and treble potentiometers at maximum and volume control at normal. Adjust the azimuth adjustment of playback head to get the maximum output. This procedure is called the head-azimuth alignment. Now recheck the action of bass and treble potentiometers along with the music. If the performance is not proper, check the components of tone control network. Then check the frequency correction network from collector of T5 to emitter of T4 through recording switch comprising R28, R29 and C32.

After satisfying yourself with the cassette playback performance, it is necessary to understand and test the recording characteristic. For this, place a recorded cassette in the slot and press both the play and recording buttons. After a few seconds, replay the same and note whether or not the circuit erases the pre-recorded signal. If it does not, check the DC voltage across the erasing head. Now, press the rec/play buttons and keep the monitor switch 'on' for a few seconds. Note the feedback oscillations from the speaker (a high frequency noise, about 2 kHz) which indicate whether the

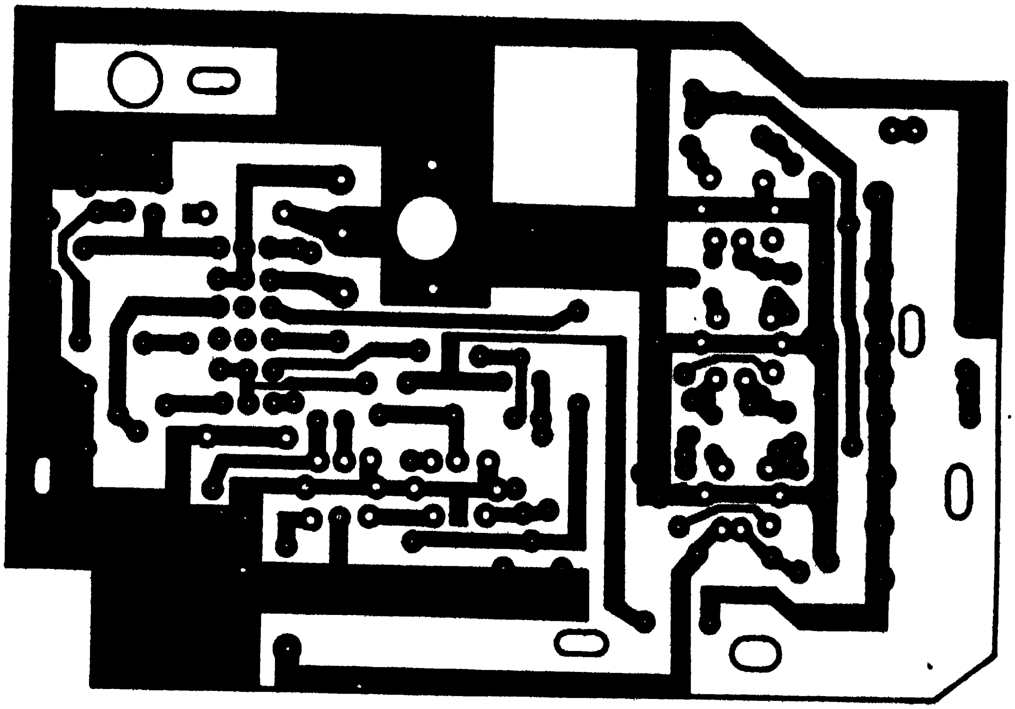


Fig. 5: Actual size PCB layout for radio board.

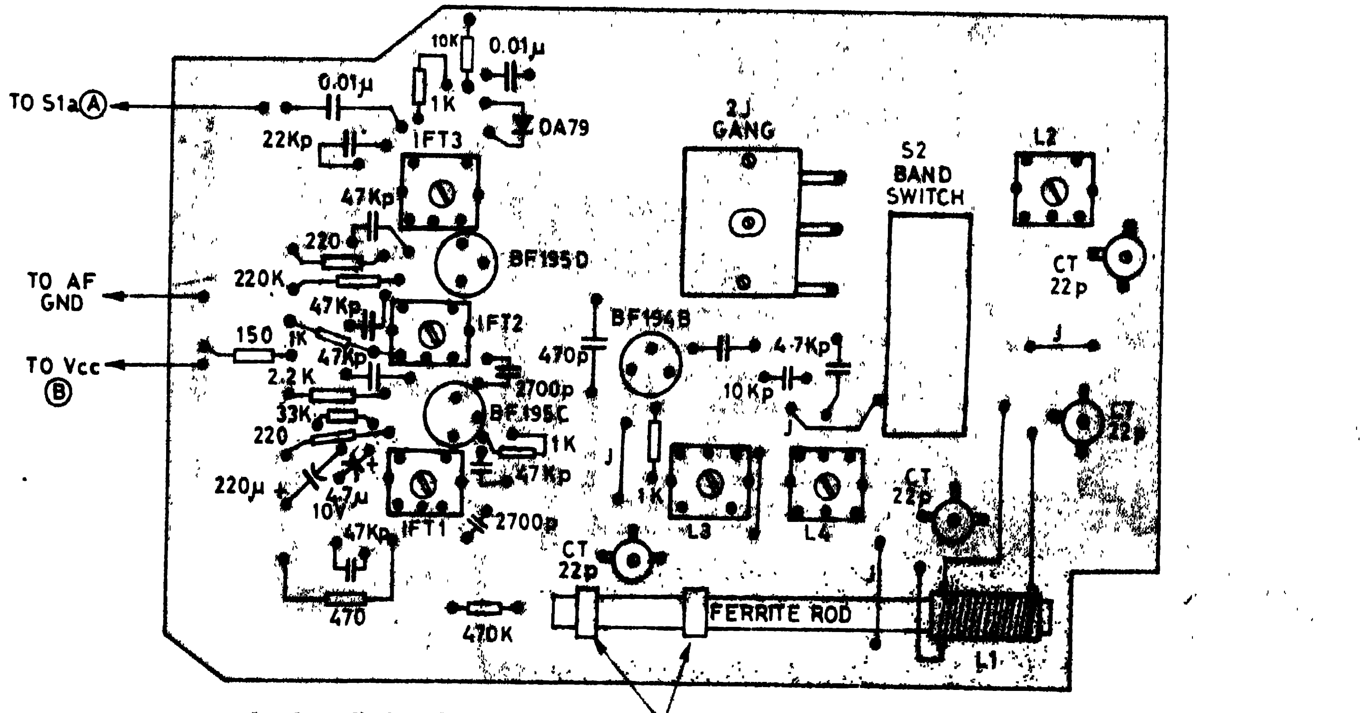


Fig. 6: Components layout for the radio board.

condenser mic. circuitry is working properly.

Next, switch off the monitor and record any signal through the condenser mic. and replay it. If there is any distortion or if the recording is not good, then: (a) check the DC bias across the recording head while recording the signal from some external sources other than mic. If there is no DC voltage across the recording head then check the bias resistor R24, (b) interchange the head connection of rec/play head, and (c) check the ALC transistor (BC148B).

After satisfying yourself with the tape playback and recording performance, it is now necessary to test the radio section.

Turn the selector switch to radio and set the volume control at normal listening level. Place the band switch at

MW position and note the output. Before checking on the radio section, be sure that it is well aligned as per the alignment chart given in Table I. If the radio section is totally dead then proceed with your testing as follows: (a) check if there is any RF interference from the speaker, (b) touch the base of the first and second IF amplifiers with a metallic object and observe the output. If any clicking sound is heard from the speaker, disconnect the primary winding of the first IFT from the collector of BF194B and touch that point with a metallic object and observe the output. If it is still dead then check the supply voltage at the RF stage and also the base, emitter and collector voltages of T1 (BF194B), T2 (BF195C) and T3 (BF195D); (c) if there is any hum or shrill sound from the speaker after touching the primary of IFT1 with a metallic object, it indicates that the IF stages are working properly, so try to rectify the faults in mixer/RF stages; (d) measure the base, emitter and collector voltages on BF194B and check the connection of coils or contacts on bandswitch with a multimeter. If there is still no improvement in operation, interchange the primary winding connection of the oscillator coils and note the output.

TABLE I
Radio Alignment Chart

Step	Band Switch Position	Signal Generator Frequency	Pointer Setting on Dial	Adjust for Max. Output
1.	MW	455 kHz	600 kHz	IFT3, IFT2, IFT1
2	MW	550 kHz	550 kHz	MW osc. coil
3.	MW	1600 kHz	1600 kHz	MW osc. trimmer
4.	MW	600 kHz	600 kHz	MW Ant. coil
5.	MW	1600 kHz	1600 kHz	MW Ant. coil trimmer
6.	SW	5 MHz	5 MHz	SW osc. coil
7.	SW	16 MHz	16 MHz	SW osc. trimmer
8.	SW	5 MHz	5 MHz	SW ant. coil
9.	SW	16 MHz	16 MHz	SW ant trimmer

Note: IF and MW alignment signals must be radiated via one turn loop placed 50 cm or 70 cm from MW antenna coil and SW signals must be fed between antenna gang and ground via 10pF paper capacitor.

Construction tips

Before attempting to assemble the project it is advisable to follow these instructions:

1. Connect all the passive components (resistors, capacitors, jumpers, transistors and diodes) on the PCB as per the component layout and solder them. Be sure that there is no dry solder connection.

2. Now connect all the active components like rec/play switch, coils, IFTs, ICs etc on the PCB as per the component layout and solder.

3. Before soldering the rec/play switch on to the PCB, take care to ensure that all the pins are inserted properly in their slots.

4. Use good quality 60/40 resin core solder wire for the soldering work.

5. After completing the soldering work for both the radio and the tape PCBs, clean the track sides with an old toothbrush, using petrol to wash away the grease. Take care not to spill the petrol over the components.

6. Now fit the tape PCB over the deck mechanism and radio as per the chassis wiring layout.

7. Use 6mm sleeves for all the wires to make the set compact.

8. Use 6BA (1.27 cm) brass screws for deck mechanism and radio chassis fittings and 7BA screws for clamps on the deck mechanism.

9. No heatsink is necessary for IC TBA810, but solder the heatsink tabs of the IC with ground point near the IC connection with a 16SWG hook-up wire.

10. Don't pass any link wires over the PCB; pass them from one side of the PCB to avoid interference or cross-talk.

11. Make good earthing with a shield wire from the ground portion of the PCB to the deck mechanism and the metal cases of the volume, bass and treble control potentiometers.

12. Use two-core shield wire for rec/play head connection and three-core shield wire for control potentiometer connections. For the erase-head connection, a general-purpose 7/36 flexible wire is sufficient. □

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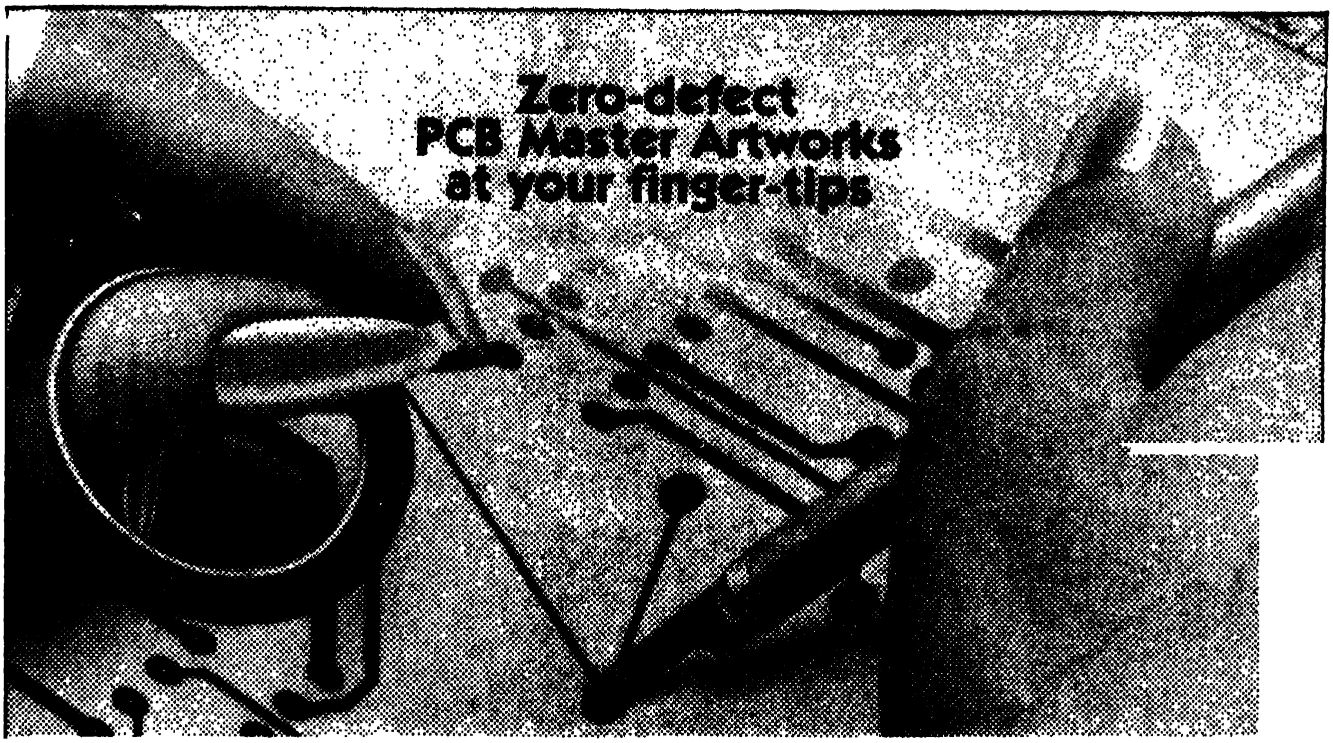

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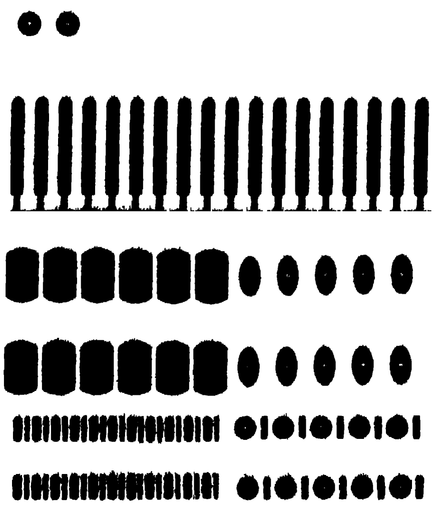

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I would be surprised if the Indian market does not explode:

Milivoj von Somogy

Milivoj von Somogy, corporate vice-president and director of strategic planning, SGS Microelettronica SpA, Italy, has been in the semiconductors field since 1954, when there were very few semiconductor companies. Born in Yugoslavia, he emigrated to Germany, where he worked for two years, then to Australia for nine years where he developed transistor radios and television. Then he moved to Hong Kong as application manager for Fairchild in 1965 when nobody in Hong Kong could design anything. He has worked in eight countries including Switzerland, Germany, Italy, and for a short while in America. This interview with Mr Somogy was recorded barely a week after he had been designated president, Asia-Pacific for SGS Semiconductor, and was on his way to his Singapore office.

What does SGS specialise in?

The three most important application areas for our products are power ICs (ICs for controls and motor drives, power pplies etc), consumer electronics and communications

you manufacture discrete devices as well?

Certainly! We are among the first three or four world suppliers of power transistors

How about MOS transistors and ICs?

Power MOS transistors and smart power are new developments of great significance CMOS IC technology being the most important for the future is used by us for semi-custom and full-custom circuits. Semi-custom includes gate arrays and a new family of standard cells. In the full-custom, we have communication circuits, television tuners, etc.

Is your manufacturing activity primarily in Italy?
In Italy we have our origin and is very significant, but Italy or the European common market is too small for a semiconductor company like ours. So our major manufacturing facility today exists in the Asia-Pacific, i.e. two large factories in Singapore and one in Malaysia. In Singapore, the old factory has been modernised completely and a new diffusion factory has been built which is so large that within a very short time, we will be able to double our wafer output. We are the only company from the developed countries having such large facility in Asia-Pacific! Of course, except Japan.

Where do you sell most?
Last year it was Germany, for the first time. Before that it was usually Italy or the United States. In 1984, which was a good year, we sold slightly over 50 per cent in Europe, one-third in the US and close to 20 per cent in Asia-Pacific.

How do you find the market for your products in India?
Our share of Indian market is very small at present, though our products fit the Indian market very well. We had not been handling the Indian market well until the end of 1984. We were handling it as a small export market from Italy but it did not work. We transferred the responsibility to Singapore, appointed local distributors and we will have our own organisation here too. So last year we had grown here four times. We are still small but the potential is large.

Could you quantify that potential?
I would be surprised if the Indian market does not explode. The market was over-protected till recently. It has now started to move towards modern industrial society, and if this continues it will grow very rapidly.

Which products do you have for the Indian market?
We feel that our product range is ideally suited to India. We are very strong in the communication field, and one of the prime suppliers to many large communication countries. Singapore is close, with major diffusion and assembly and a large design centre and application, just to respond to the local needs. If finished goods are not admitted, we are prepared to sell dice or wafers.

What are your views about setting up a plant in India in collaboration with an Indian company?
I believe that this would be both of an advantage and, possibly, a necessity in the long run. We have had a number of discussions with potential partners. But we certainly have a lot of work to do in India before the market develops and allows such a project. For instance, we have to offer application services operation on economic base.

Have you observed anything peculiar in the Indian industry that does not exist elsewhere?
I have lived so far in eight countries and my Singapore assignment will take me to the ninth. Good people exist everywhere. There is no difference in India which has excellent 'people potential'. However, India lacks experience and opportunity. When I look at TV manufacture in India today, it uses mostly a complete kit of imported parts. That is typical for early development of a country where it is the simplest way to be sure that everything is working fine. But, it is a temporary arrangement because it is an extremely costly arrangement.

Why in your opinion are prices of most electronic equipment, or even components, high in India?
It is very simple! You do not have a volume, but you have high taxes and duties. However, there are some highly successful companies (like Tandon), producing for the world market. So it merely means that you are in the early stages of industry development. Every move to lower duty will lower prices and create a much larger market.

What is the major problem for a semiconductor company like yours today?
The major problem is capital. Semiconductor companies today are spending almost one dollar for every additional dollar of sales per year! This is a tremendous capital involvement. There is in fact a huge battle of capital investment between Japan and America.

We are a relatively small company and yet in 1984 we spent 145 million dollars, i.e. 45 per cent of our sales in capital investment, and in 1985 it was still over 40 per cent. Plus we spent 14 per cent in research and development. So the amount of cash required is huge.

Our figures are much higher than the industry average which is at 18 to 20 per cent. We spent more because we wanted to grow faster. My suggestion is that India should not spend much on diffusion yet. It is ready for assembly and test which is cheaper and also easy. The size of the market in India is not yet big enough for diffusion. But, if and when the market expands diffusion will be established anyway.

As the technology is changing very fast, isn't it risky to invest in this industry?
Every industry which is growing fast is risky. When I see the huge American market, I find only four TV manufacturing companies there. In India, 500 companies are trying to make TV sets. By 1990, I forecast India will be producing ten million TV sets a year, but there will be, may be, only ten TV companies left in the field. So the other 490 are taking a very big risk. But, many of them will survive, making something else, trading or servicing. □

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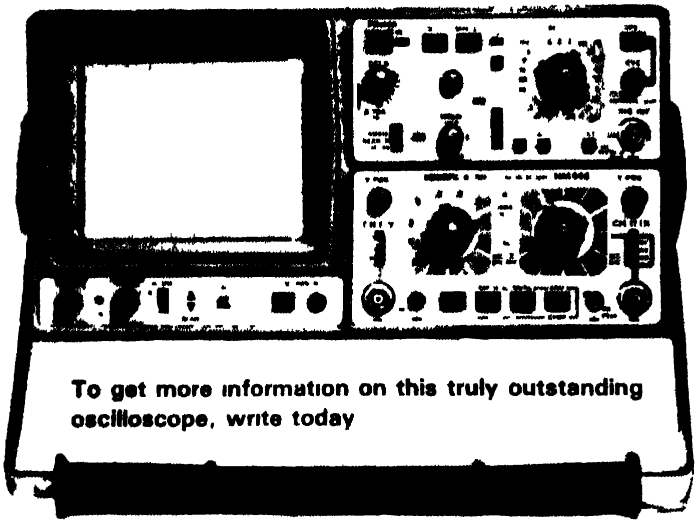

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5 Z Mod	No	Yes	For 3rd Axis Display
6 Analog Y Output	No	Yes	For further signal processing
7 Single Sweep	No	Yes	For viewing non repetitive transients
8 Component Tester	No	Yes	For quick testing of components in circuit or otherwise
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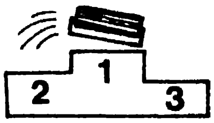

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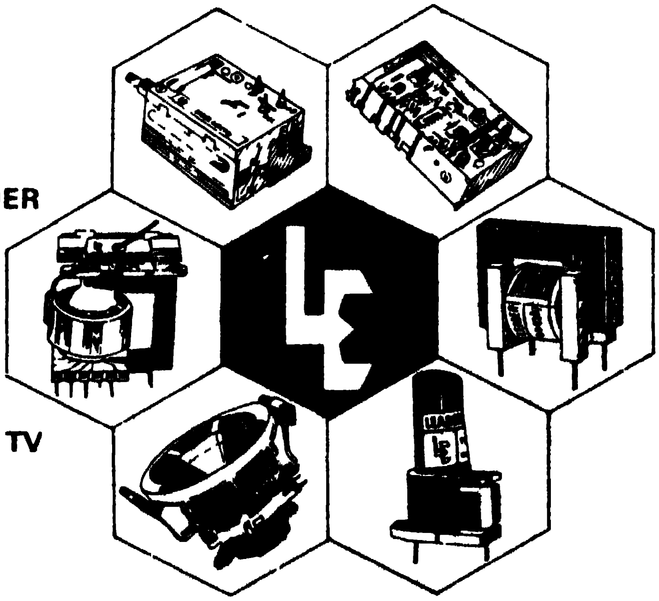

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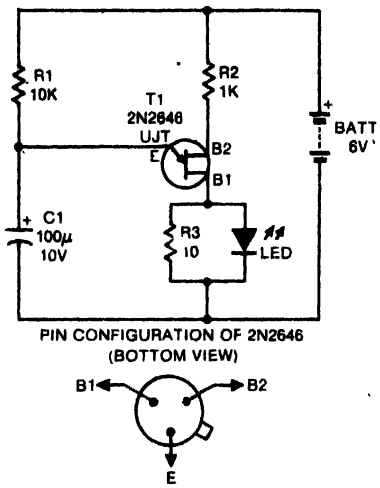
Simple Flasher Using UJT

This circuit uses the UJT (uni-junction transistor) which is not so frequently used. The UJT, which is used as a relaxation oscillator here, is the heart of the circuit. It may be operated on a 6V or 9V battery.



All the resistors used are of ¼W. The output pulses obtained at B1 are applied to the LED, thereby causing it to turn 'on' and 'off' alternately. A 10-ohm resistor is placed in parallel with the LED to bypass the DC signal when there is no pulse at B1. If the LED is not bright enough, increase the value of the 10-ohm resistor to 100 ohms depending on the type of LED used. The frequency of the flasher may be changed by changing the value of capacitor C1 used.

SANDEEP KHANNA

Bulls and Cows Game

A circuit for the 'bulls and cows game' was published in the February 1984 issue of EFY. The circuit utilised 15 ICs. In contrast, the circuit given here utilises only twelve transistors and ten diodes with two displays (three LEDs per display). It costs only around Rs 50.

In the game, the number of bulls and cows is indicated in Roman numerals (I, II, and III) by LEDs D6, D7 and D8 arranged in a row. Table I shows various combinations of A, B, C inputs required to light up the display. From the table it is clear that when any one of the inputs is logic 1, D8 should light up; when any two of the inputs is logic 1, D8 and D7 should light up; and when all the inputs are logic 1, all the three LEDs should light up. This is achieved by making use of the circuit shown here. Two such units have to be constructed—one for indicating 'bulls' and the other for indicating 'cows'.

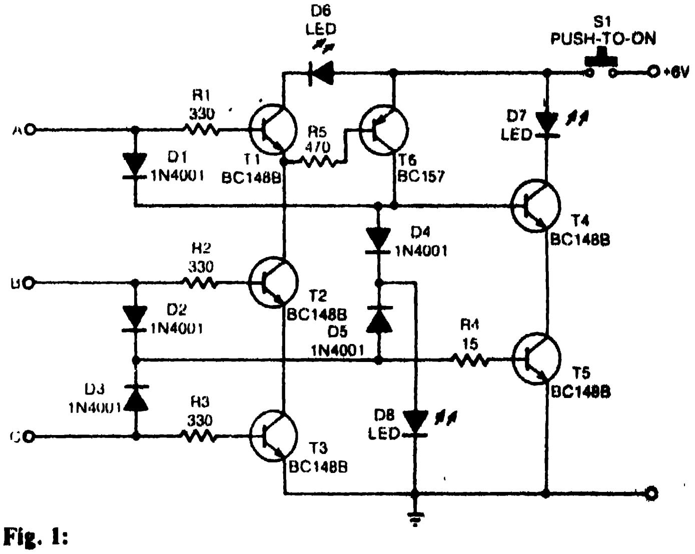


Fig. 1:

The circuit can be constructed on a general-purpose strip board. Wiring diagram for the rotary switches with the correct combination as '234' is shown in Fig. 2. This combination can be changed to meet individual tastes. The circuit is powered by four cells in series. The circuit can also be powered by the mains through a suitable stepdown transformer but the former is preferred since it would make the gadget portable.

Fig. 2:

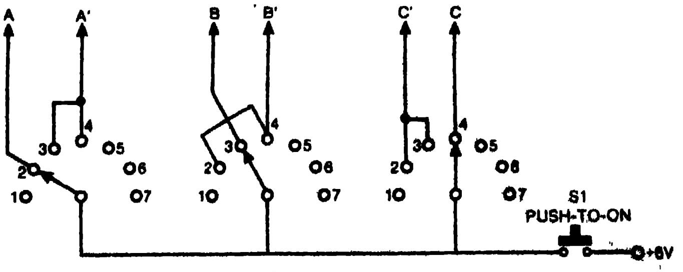


TABLE I

A	B	C	D8	D7	D6
1	0	0	1	0	0
0	1	0	1	0	0
0	0	1	1	0	0
1	1	0	1	1	0
0	1	1	1	1	0
1	0	1	1	1	0
1	1	1	1	1	1

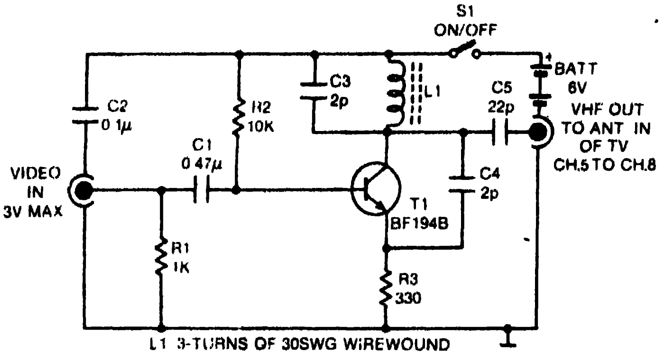
Two persons are required to play this game. One person sets the suitable combination, while the other tries to guess the combination by choosing a number by rotating the three switches. On pressing pushbutton S1, the result is displayed. If nothing is displayed it indicates that the person has not been able to guess the numbers. If the 'bulls' display lights up, it is an indication that the number has been guessed correctly. The 'cows' display indicates that the numbers have been guessed correctly but are not in order. This game is sure to provide hours of fun to the readers.

RANJIT S. MALHOTRA

VHF TV Modulator

Any equipment having a video output, like a VDU card for instance, needs a modulator to enable us to see the video information on the TV screen. The VHF modulator described here accepts an input of about 3V peak to peak or less and modulates the carrier (RF) with this input. The VHF modulator can be tuned to channels between 5 and 8. It is capable of producing black-and-white as well as colour picture.

The power should be supplied from a battery. Power supply can be taken from the mains also but a voltage regulator should be used to keep the ripples minimal. Ripples in the supply cause distortion in the picture and a humming sound in the loudspeaker of the TV. L1 is wound on a plastic former of 8mm diameter (the details are given below the circuit) and C3 soldered on to the pins of the former. The ferrite core is adjusted so that the TV receives the signal from the output of the modulator. If the circuit is tuned to channel 8, the TV should receive the output in channels 7 and 9 also, but to get the maximum effect, the TV should be tuned to the same channel as this modulator.



L1 3-TURNS OF 30SWG WIREWOUND ON 8mm FORMER WITH FERRITE CORE

The circuit does not draw more than 5 to 6 mA at 6V.

Lab Notes:

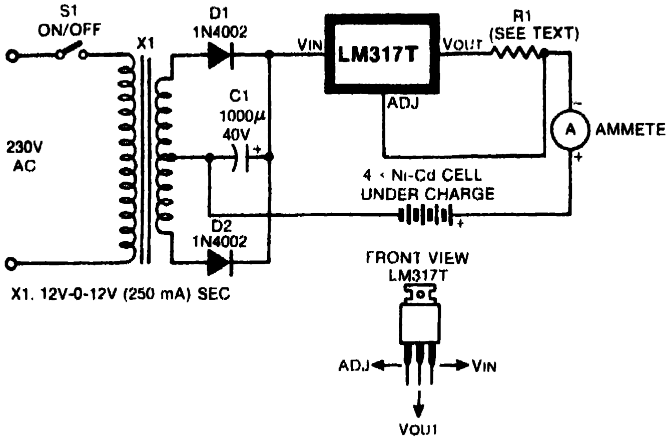
1. An external metal can should be fitted over the oscillator coil L1 to remove the RF interference and colour snow over the screen. Low voltage and unstabilised supply also cause a negative picture with snow on the screen as noted while testing the circuit in our lab.

2. If desired for use with channel 2 or channel 4, either a 22pF button trimmer can be connected across C3, or the number of turns in the coil winding details of L1 should be increased by two or three (in addition to the three turns as mentioned).

C. SANJAY

Simple Ni-Cd Battery Charger

This Ni-Cd battery charger is a circuit based on the regulator IC LM317T. This circuit is very simple and uses minimum components. By varying value of resistor R1 from 1 ohm to 120 ohms, charging current can be varied from 10 mA to 1.25 A. This circuit functions as a constant current generator.



Construction is fairly simple and it can be constructed on a veroboard or tag board. As a general rule all Ni-Cd batteries should be charged at the maximum charging current of 1/10 ampere-hour rating of the battery. This should never be exceeded. Exact charging current can be set by using a potentiometer or a preset in place of R1 and putting an ammeter or multimeter in series with the load. As the maximum input voltage to IC is 40V, input voltage should always remain less. Proposed circuit is suitable for charging four cells in series. But the maximum number that can be charged will depend on input DC voltage to regulator.

This circuit is very rugged and reliable. Output current is virtually independent of load and can be controlled very precisely. Almost any type of Ni-Cd battery can be charged. IC should be fitted with heatsink (LM317T is plastic package of LM317K with same rating but costs only half as much). Typical specifications for a Ni-Cd cell are as follow:

(a) Nominal 1.2V—full charge 1.4V.

(b) Charging rate max. 10 mA.

(c) Charging time max. 12 hrs.

(d) Discharge rate on storage is 0.014V/24 hrs.

(e) Totally discharged cell recovers fully on 12hrs charging

(f) Electrolyte seepage does not affect performance. Wipe cell with dry cloth.

A SEHGAL

Three- Dimensional Viewing of Graphic Displays

Arthur Fryatt

A look around any research, manufacturing or business establishment clearly shows how the communications technology revolution has resulted in the growth of applications for the cathode ray tube. Many people, already used to watching television in the evenings, now spend much of their working day entering and receiving information on a visual display unit (VDU).

In most applications, the two-dimensional image displayed is perfectly adequate for showing messages, figures and simple diagrams related to business information, accounts, process data and machine setting tables.

The three-dimensional imaging system.

However, when computers are used in advanced technology and scientific research work- as the application of computer aided design (CAD) to biophysics for the study of complex. molecular structures—serious limitations occur, because without true picture depth, molecule fitting is extremely difficult. Although many computer imaging systems used in CAD technology are capable of producing perspective views from different view points, they will not display true visual depth because no stereoscopy is involved.

Perception of depth

In human sight, stereoscopic vision is achieved by eyes seeing slightly different views of the object, with the brain combining them to give the perception of depth. A single two-dimensional picture cannot give this illusion, but it is possible to emulate the effect by generating two images of an object, corresponding to the views that would be seen by the left and right eyes, and contriving to have each separate image viewed only by the appropriate eye.

One method of providing a stereoscopic image is to separate the views laterally on the screen so that there is no overlap, and to direct the light from each to the appropriate eye using lenses, mirrors, prisms or systems of polarising filters. Apart from the inconvenience of having an optical system mounted on the screen, a major disadvantage of this method is that only half the screen area is available for each image, while it is difficult for more than one observer to view the screen at the same time.

Alternatively, the left and right images may be drawn in different colours (such as red and blue, as used in three-dimensional films) and viewed through spectacles with correspondingly coloured glasses to filter out the unwanted image. Although with this method the whole screen area is utilised for each image, the valuable information content of a fully coloured image is lost.

A technique that does not suffer from these disadvantages is tachistoscopy, or frame sequential stereo. With this technique, the left and right views are displayed on the screen alternately, and the view of each eye is obscured in synchronism with the display of the unwanted image. As long as the frequency of alternation is sufficiently high — above about 25 Hz — there is no appreciable flicker of the picture.

Shutter mechanism

Devices available to provide tachistoscopy differ in the shutter mechanism employed to obscure the alternate views.

In one type of mechanical shutter, sometimes referred to as the revolving beer can system, two coaxial cylinders are mounted horizontally and parallel to the screen. An observer looks at the screen through slots at the front and back of the outer cylinder. The inner cylinder rotates and has windows positioned so that a clear view of the screen is seen by one eye when the view of the other is obscured, and the situation is reversed when the inner cylinder rotates through 90 degrees. The rotation of the inner cylinder can be synchronised to the frequency of alternation of the images by direct coupling of the electric driving motor to the screen refresh hardware, or by locking on to the mains frequency if the refresh circuitry also uses the mains for its timing.

The problem with mechanical devices is that they are cumbersome, heavy and expensive, and it is often difficult to synchronise the shutter with the image alternation frequency.

The disadvantages inherent in mechanical shutters are overcome by the use of electro-optical shutters, but only recently has it become possible to achieve sufficiently high shuttering speeds, coupled with acceptable degrees of transparency and opacity when shutters are opened and closed respectively. The first successful electro-optical shutter employed lead lanthanum zirconate titanate (PLZT) ferroelectric ceramics. This type of shutter depends on the birefringent property of PLZT materials when subjected to an electric field.

Blocked by the polariser

If a PLZT ceramic wafer is sandwiched between the front and rear polarisers, with axes at right-angles and parallel to the plane of the wafer, then, in the absence of an electric field, the light penetrating the wafer is blocked by the polariser. However, if a sufficiently high voltage is applied, the polarisation of the light beam is rotated on passing through the wafer. The wafer is chosen so that the rotation is 90 degrees and the light can then pass through the rear polariser.

PLZT devices provide an acceptable stereo effect but are expensive, have a low maximum light transmission of about 17 per cent and have high operating voltage potentials of about 500V DC across the wafers, which are mounted in spectacle frames.

With three-dimensional imaging required for the study of complex protein molecules, the Astbury Department of Biophysics at Leeds University in northern England has developed an electro-optic shutter employing liquid crystalline materials sandwiched between front and rear polarisers. In this process, the light is transmitted in the absence of an electric field because the application of a suitable field disturbs the alignment of the liquid crystal molecules and causes the shutter to become opaque. The device costs relatively little, has a maximum light transmission level about double that of the PLZT device, and uses a lower operating voltage of about 30V.

So successful has this new system proved that six prototypes are already in use at British universities, and a commercial company, Millenium, UK, which has extensive experience in the design and development of microsystems, has been licensed to market the equipment.

More than one person

The stereo viewer consists of an electronic control unit, a photo pick-up and a pair of viewing spectacles. The control unit is capable of supporting up to four pairs of spectacles, so that more than one person can view the image at the same time. A pair of stereo images and an optional synchronisation signal are generated on the graphics screen. The signal is detected by the optical sensor, causing the lenses in the spectacles to alternate between transparency and opacity. This synchronisation between left and right lenses allows a true three-dimensional image to be viewed.

The software driving the graphics terminal regularly alternates the displays of left and right eye views of the object at a frequency of 25 Hz, which corresponds to one image per refresh on most high performance graphics devices, or one image per interlace cycle on interlaced raster screens. Left and right eye projections of an object at a nominal viewing distance of 1 m can be generated from the three-dimensional coordinates by performing a rotation about the conventional Y axis of the object of approximately ±2 degrees.

In the future, it may be possible to cover the whole of a screen with a single liquid crystal cell so that the viewer could wear spectacles containing only polarising glasses, thus eliminating the need for trailing wires. At present there are difficulties in manufacturing such large single cells, and the stereo effect could be impaired if the viewer's head was tilted.

There seems little reason why the system should not be used with normal entertainment television pictures. An additional pair of spectacle lenses could be mounted in front of the camera lens and the light from the two cells directed into the lens with the aid of prisms or mirrors. This would provide alternating left and right images on the screen, for viewing through spectacles. □

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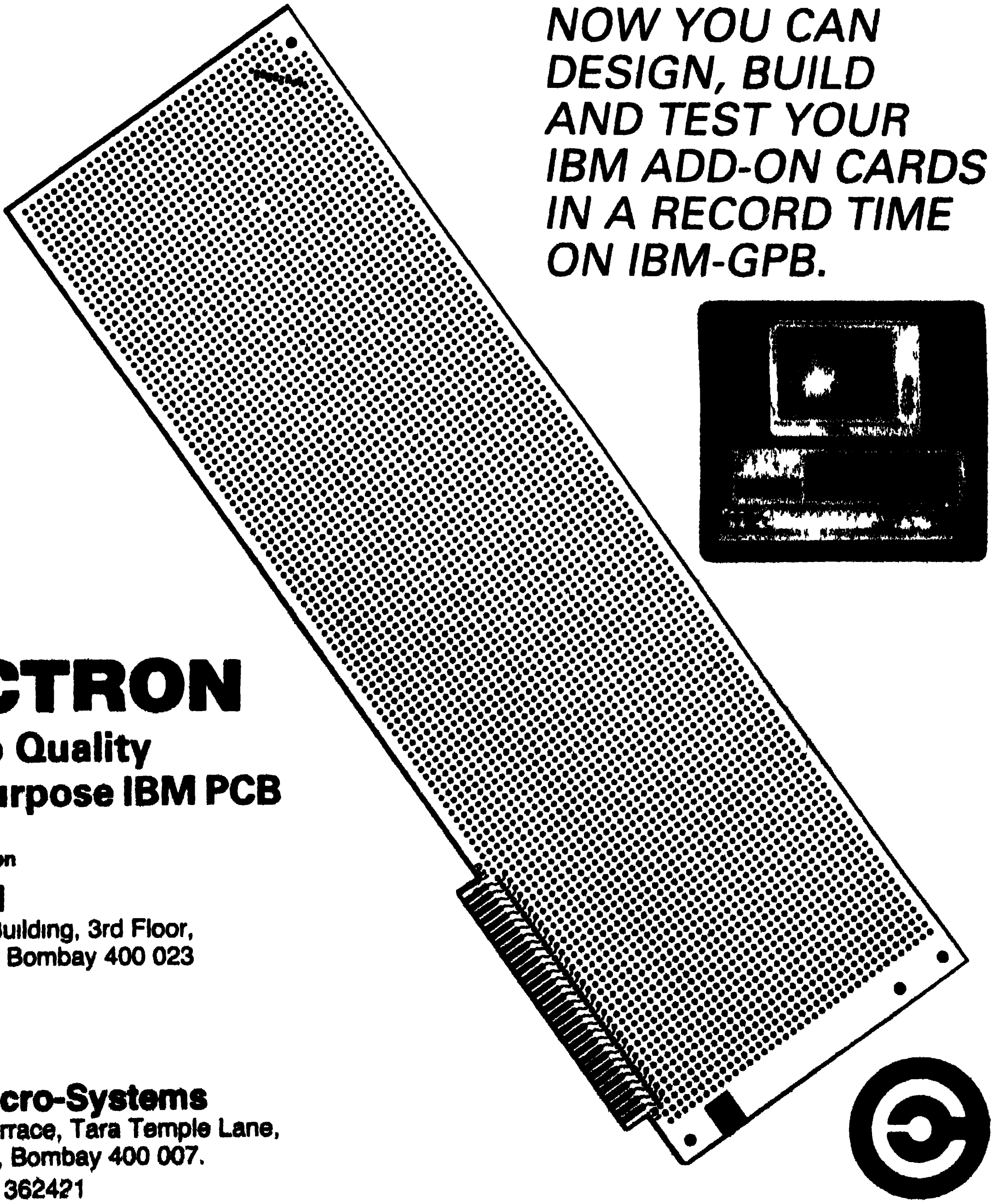

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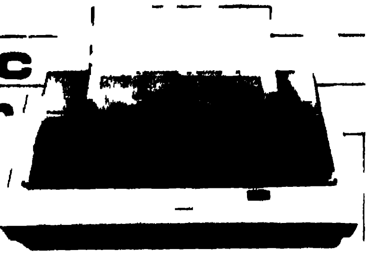

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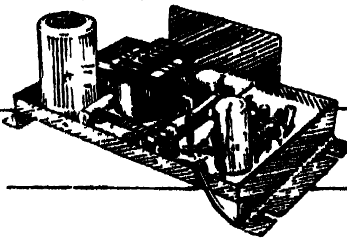

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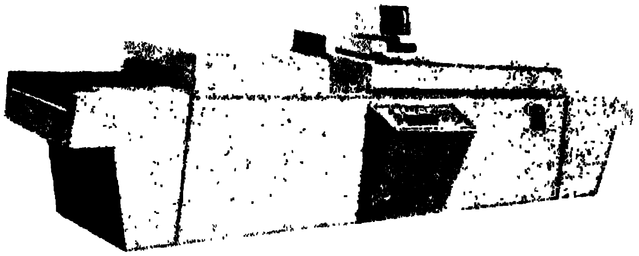

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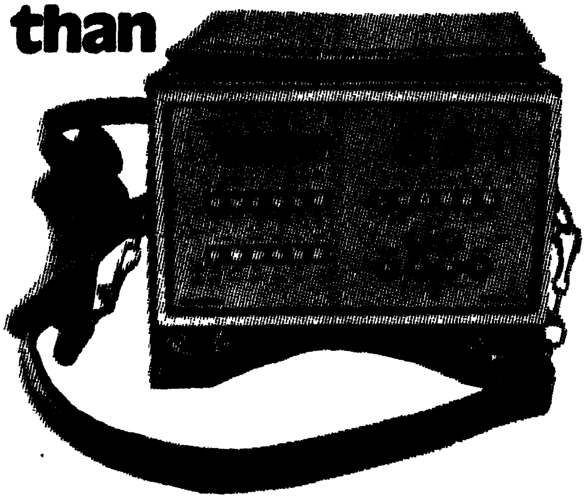

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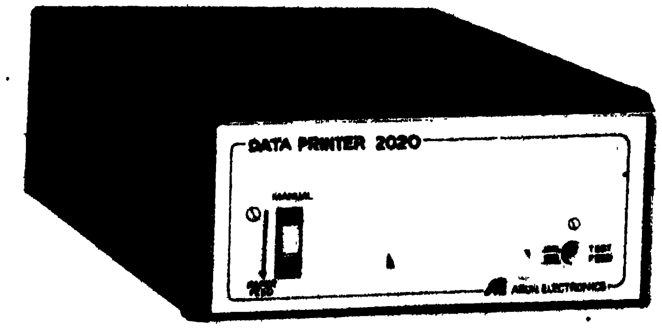

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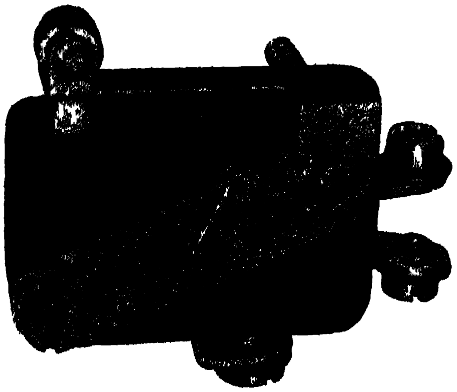

MICRO SWITCH

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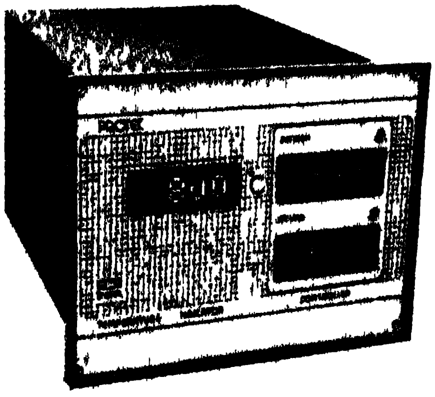

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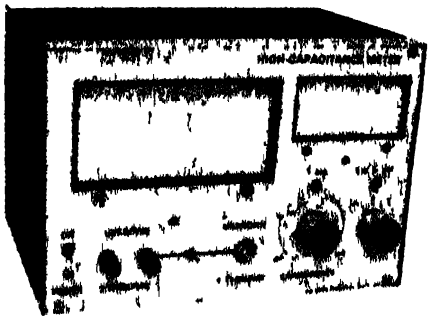

HIGH CAPACITANCE METER

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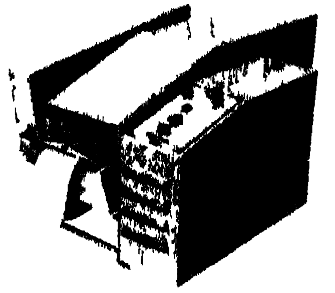

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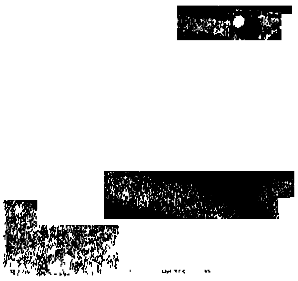
FUNCTION GENERATOR

This Function Generator FG-[illegible] is convenient for use and offers excellent waveform accuracy at an affordable price. Frequency coverage is unusually wide, spanning 0.1 Hz to 1 MHz in six ranges, with each range providing linear 1000:1 frequency control.

It performs various [illegible] such as frequency response, [illegible] amplifier overload characteristics, [illegible] square wave evaluation, [illegible] control evaluation, [illegible] and bias signal [illegible]

[illegible] range and function selection [illegible] error-free operation. The stable voltage controlled oscillator (VCO) is varied [illegible] by the front panel frequency control [illegible] VCO external input. A 0 to 5.5V [illegible] the VCO external input provides a 100:1 output frequency change. By applying such an input ramp, it can be used as a sweep generator for response measurements in audio and IF circuits. When an audio

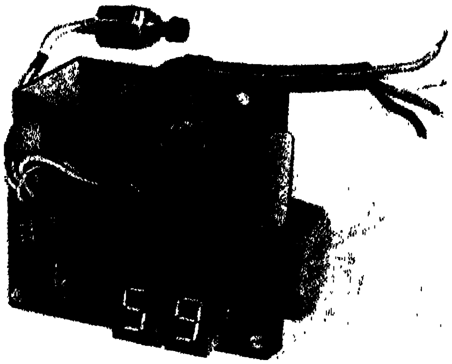


FUNCTION GENERATOR

signal is applied in place of a ramp, it produces a direct FM output.
Contact: Logics, 107, 6th Main Road, 8th Cross, Malleshwaram, Bangalore 560003.

DIGITAL COUNTDOWN TIMER

This is a timer ideal for any electrical appliance which is required to be switched off automatically after a certain amount of time. It consists of transformer, printed circuit board (PCB), relay and piezoelectric buzzer: all mounted on a passivated m.s. chasis. The PCB is degreased, ultrasonically cleaned and lacquered for protection from moisture. The relay rating is 6 amps (resistive) at 240V AC. 10 amps relay can be provided on request.



DIGITAL COUNTDOWN TIMER

As soon as mains supply (230V AC + 20%) is connected, the buzzer sounds, while the display remains blank. On pressing the pushbutton, the display glows, buzzer silences and the relay pulls in. This switches on the electric appliance connected through the relay N/O contacts.
Contact. Ion Electricals, 307 Owner's Industrial Premises, 505 Gabrial Road, Mahim, Bombay 400016.

INCHING MODULE

This is a reliable electronic circuitry useful for inching and positioning a variety of M/c tool and equipment tables, spindle, and other moving elements of a machine. The module requires a 230V AC input and gives a pulsed ariable as per the customer's choice output relay with change-over contacts

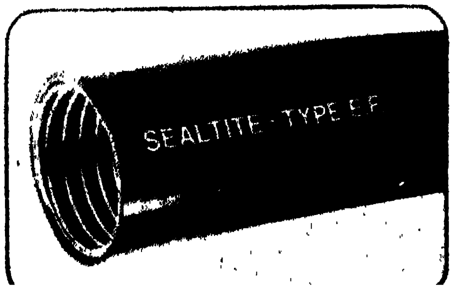
INCHING MODULE

(1 NO + 1 NC) capable of switching 230V AC at 6 amps. This power handling capacity can be enhanced by an interfacing contractor.
Contact: Accord Corporation, 'Juhu Jiven', Block No. 135, Samarth Ramdas Marg, Juhu, Bombay 400049.

WIRING CONDUIT

This Sealtite Flexible Liquid-tight Conduit is the first of its kind in the industry. It is made from galvanised steel strip continuously wound to form a strong, flexible core which is protected by a smooth liquid-tight thermoplastic cover. The construction combines strength and flexibility. It withstands high compressive stress, tensile strain and is crush-resistant. The thermoplastic cover is ribbed on the inside to prevent core creepage. It protects wiring from liquids, dirt, dust, fumes, abrasion and weather.

It is designed to prevent power failure and accidents under severe conditions. The materials used are of the highest quality. The smooth, flexible thermoplastic cover is impervious to water, chemicals, various oils and thermal influences. Its uniformity assures proper connector attachment and effectively seals out harmful elements. Dust, dirt and grease are easily removed from the surface of its core. Sealtite makes installation fast and easy. Cutting is easy with a standard hacksaw. It is available in black and grey colours.



WIRING CONDUIT

Contact: Suresh Electrics & Electronics, 3B Camac Street, Post Box No. 9141, Calcutta 700016.

FLOW COMPUTER

This new Dart Flow Computer delivers ±0.1 per cent accuracy at 20-50 per cent lower cost. It has simple rate and LCD total display for liquids and steam and can be programmed to handle temperature, pressure and other compensating functions for gas, mass or BTU flow rate measurement.

It is compatible with all DP flow primaries, offers diagnostic test functions for troubleshooting and calibration checks on other system components and accepts multiple transmitter inputs for high turndown of up to 16:1.

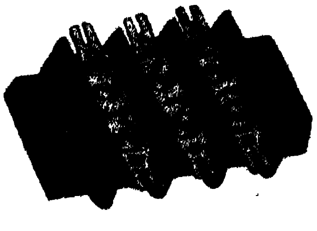
The new dual, digital averaging feature conditions pulsating transmitter signals for accurate interpretation whether for local readout or for input to large, central computers.

FLOW COMPUTER

Contact: Chandak Instruments, 84/5 Mahajan Building, Main Road Sitabuildi, Nagpur 440012.

BARRIER TERMINAL BLOCK

This Barrier Terminal Block is manufactured to international standards. It is approved by LCSO Bangalore and is available in 5,10 and 20 ampere current ratings with wide choice of terminals and accessories and from 2-22 number-of-ways in bakelite or melamine in different colours.



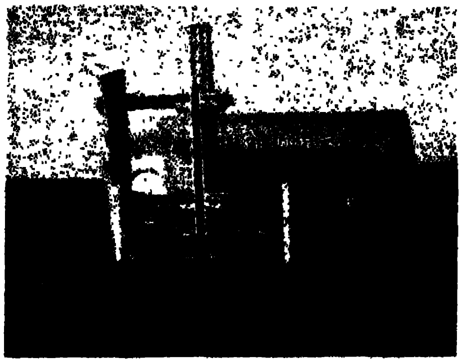
BARRIER TERMINAL BLOCK

Contact: Electrols, A 27-28 Royal Industrial Estate, Naigaum Cross Road, Bombay 400031.

AUTOMATIC COMPONENT PREPARATION MACHINE

This totally indigenous air-operated, Automatic Universal Component Preparation Machine CA-22 is capable of preparing the entire range of components (axials, radials, transistors, ICs and other multi-lead components) with tailor made tooling.

A unique feeding system allows a smooth



AUTOMATIC COMPONENT PREPARATION MACHINE

and drag-free feed of components to the machine for preparation. Flexibility of operation, feeding and range of components that can be handled, render the machine extremely useful for both small and big batch runs. The machine is capable of outputting 6000 components per hour. Changeover from one component geometry to the other is very simple and requires minimum of time and skill.

The unit operates on compressed air (60 psi max.) and has two modes of operation—'manual' for hand feeding and 'automatic' with a proper feeding system. Speed of operation can be controlled and the machine auto-paced to match the feed rate. Tooling for a whole range of geometries is available with the machine.

Contact: Control Signals, 62 Hari Nagar Ashram, New Delhi 110014.

REGULATED POWER SUPPLY

This Regulated Power Supply for circuit designing and laboratory applications is available in the 0-30V, 0-150V and 0-300V DC ranges. Dual power supply and custom built models are also available.

The salient features of the power supply are: sturdy body which can withstand rough handling, easily accessible output terminal, large dial scale for easy reading, and in-built over-load protection circuit.

Some models have over-load indicator and reset circuit for protection. Very suitable for schools, colleges and R&D labs for circuit design.

Contact: Industrial Marketing & Services, 42/1243 Nehru Nagar, Kurla East, Bombay 400024.

DISC-TAPE CONTROLLER

A double-Eurocard disc and tape controller connects the VME bus systems to two storage module device (SMD) discs and four QIC-02 6.5mm cartridges. Compact PCB-design on one standard double height board, user programmable drive characteristics for conventional and winchester disc drives with SMD/CMD/MMD/LMD interfaces are some special features.

It controls two disc drives, has dual access option, transfer rate up to 15 Mbits/sec, very fast multi-sectoring data transfer at full speed, QIC-02 interface for backup on a streamer tape, and soft sectored and hard sectored track formats.

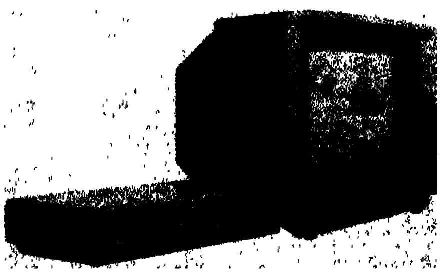
Special commands are provided to read factory flaged media-defect information from the drive, error correction logic for burst errors up to 11-bit length and extensive controller and drive diagnostics.

DISC-TAPE CONTROLLER

Contact: SPS Technical Electronic Pvt Ltd, 157 Housing Board Colony, MSK Mill Road, Gulbarga 585103, Karnataka.

TELETEXT DECODER

This Teletext Decoder does not require that the customer buy a new TV. It can be interfaced with any TV set. All that is needed is to add a circuit to the TV depending on its make.



TELETEXT DECODER

Contact: Indo Japan Auto Electronics Ltd, Flat No. 108, E-588 Greater Kailash II, Near Savitri Cinema, New Delhi 110048.

PORTABLE APPLIANCE TESTER

Thorn Emi Instruments Ltd, UK, has launched this PAT2 portable Appliance Tester designed to test the safety of portable electric appliances, and is specifically developed to cater for the variety of mains supply voltages and appliance plug types used by overseas customers.

Marketed under the Megger brand name, it is used for checking the electrical safety of earthed appliances and double insulated appliances. In addition to preventing accidents, it can save down-time of vital equipment and reduce maintenance of wiring.

PORTABLE APPLIANCE TESTER

The instrument performs five tests on an appliance, namely, earth bond, insulation, flash, load and appliance operation test. By simply pushing the test button a neon-light indicates that a test is taking place. Readings are shown on an analogue panel meter which incorporates a 'green 'pass-band'.

For load testing, a special feature is a triple coloured arc which identifies good, suspect and failed tests. The meter has a 'live zero' to indicate the presence of the test voltage.

Contact: Jost's Engineering Company Limited, 60 Sir Phirozeshah Mehta Road, Bombay 400001

LASER BEACON 5000 SERIES

Laser Beacon 5000 Series popularly called as the Triple Grade Laser is a multipurpose laser. The heart of the system consists of transmitting unit with a laser and a rotating head rotating at 720 RPM (The rotating head can also be removed for vertical plumbing or pipe laying applications). The reference beam emitted by the transmitting unit is received by the 360° receiver system mounted on graders, scrapers, dozers, excavators etc., and continuously accepts signals and sends grade information to a light display indicating 'high', 'low or 'on grade'.

Contact: Toshni-Tek International, 267 Kilpauk Garden Road, Madras 600010.

AUTOMATIC LIGHT CONTROL SWITCH

GELCO Auto Photo is a big power saver for large external lighting installations where switching off the lights is dependent. It switches on the lights at night and switches off the lights during day time. It also does voltage stabiliser function, so that you can save your bulbs from getting fused.

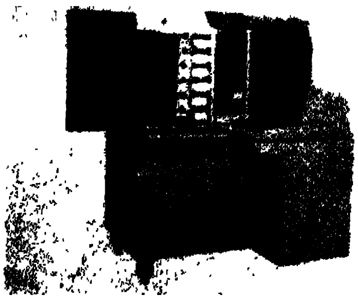
It employs a light sensor exposed to the natural light in open space. From the collected diffused ambient light it generates an electrical pulse. The above electrical pulse activates a light dependent resistor which cuts off the electric current. It can be adjusted through a knob. It operates on 220V, 50Hz supply from the mains.

Contact: MRK & Brothers Engineers, 310A, Commerce House, Nagindas Master Road, Fort, Bombay 400023.

AUTOMATIC TOROIDAL COIL WINDERS

Taga, Japan manufacture a range of Automatic Toroidal Coil Winders that makes toroidal winding a very simple affair

A model for every application is available and toroidal transformer applications to very large sizes for variac and current transformer applications could be wound using these machines. They could also handle wire diameter from 0.08mm to 3mm.


AUTOMATIC TOROIDAL COIL WINDERS

These could be used with great advantage in power supplies, medical, analytical, test and measuring instruments, etc.

Contact: Murugappa Electronics Ltd, Tiam House, 28 Rajaji Road, Madras 600001.

AEROSOL PRODUCTS

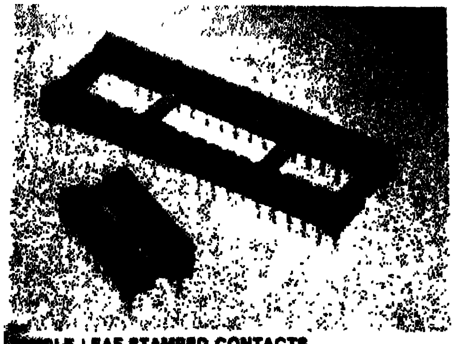
Russo Electronic Industries has developed Aerosol products for the easy maintenance of the contacts, for cleaning rust from any kind of surface and for cleaning the welding spatters in electrical and electronic instruments These have been formulated to clean the affected spot in just one spray, to penetrate even the grooves of screws and nuts to clean them from rust, and help in giving better result of the welding rod and the welding.

Contact: Industrial Marketing & Services, 42/1243, Nehru Nagar, Kurla (East), Bombay 400024

SINGLE-LEAF STAMPED CONTACTS

A new series of Single-Leaf Stamped Contacts is now available from Garry Electronics, a division of Brand-Rex Co The low profile SC-type sockets offer the reliable performance of closed entry, high pressure contacts and the economy of stamped contacts in a single unit.

A design feature of this SC series is the integral solder trap on each contact which prevents solder wicking. This permits easy removal of components during field repairs Open frame body construction improves air circulation and heat dissipation, and also permits better viewing of circuitry underneath The SC-type sockets are available in two series; the SC110, spacing; and the SC320 series.


LE-LEAF STAMPED CONTACTS

Contact: Al-Tronics International, 243, Dr Cawasji Mormusji Street, Bombay 400002.

SINGLE-ROW ELEVATOR SOCKETS

Single-row Elevator Sockets, manufactured by Aries Electronics Inc, USA are used to mount displays of non-standard in elevator style

Without extra hardware the displays can be raised to the height needed, i.e. from 9 mm to 31 75 mm. Single rows of two to 34 position elevator sockets can be held firmly to the desired center spacing using space bars prior to wave, dip or hand soldering. After soldering spacerbars may be removed or reused

Socket body is glass filled thermoplastic with tinplated berillium copper bifurcated contacts

Contact: Echbee Corporation, Kamer Bldg, 38 Cawasji Patel St., Fort Bombay 400001

TRIPLE 8-BIT HYBRID DAC

Analog Devices has introduced the HDL-3805/3806 Triple 8-bit Digital-to-Analogue Converter (DAC) which features three on-board video DACs and three ECL random access memory (RAMO look-up tables (LUTs) in one hybrid device.

By replacing three DACs and three LUTs with the smallest RGB video generator available, designers can save board space and improve reliability over discrete approaches

TRIPLE 8-BIT HYBRID DAC

The device also features a fast settling time of 12ns maximum and high write rates of 85 MHz minimum making the hybrid well suited for high speed raster scan applications.

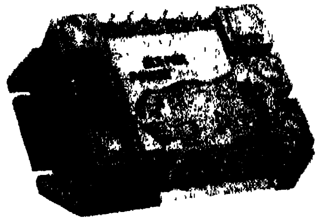
In addition to raster scan graphics systems, the devices are also used in TV video reconstruction, digital VCOs, imaging systems, CAD/CAM systems, analytical instrumentation, or any application requiring ultra-fast voltage or current output settling.

The HDL-3805 can be used in asynchronous composite operation because of its unlatched composite inputs. The HDL-3806, with latched composite inputs, is optimised for synchrous operation.

Contact: C.H. Krishnan & Associates Private Limited, Kamal Theatre Building (Ground Floor) Safdarjung Enclave, New Delhi 110029.

MOSFET POWER MODULE

Gentron introduces a new 3-phase MOSFET power module, part number EFM159-M4.


MOSFET POWER MODULE

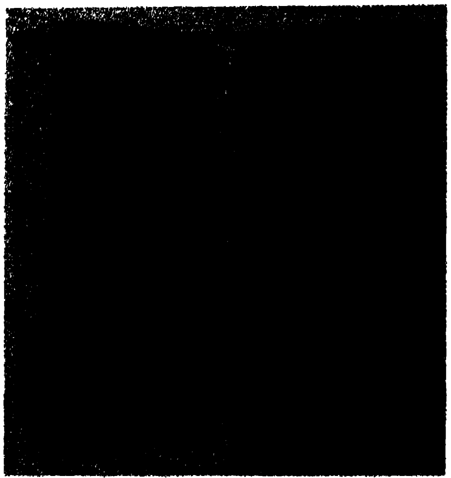
Rated at 80A/100V, this module is specifically designed for high power switching applications such as motor control and switching high power inductive loads. Three other models are also available rated at 60A/200V, 30A/400V and 26A/500V.

These modules are constructed using the patented 'Powertherm' process to ensure superior performance quality, reliability and 2500-volt electrical isolation.

Contact: Gentron Corporation, 6667 North Sidney Place, Milwaukee, WI. 53092, USA.

ELECTROSTATIC SPEAKER SYSTEM

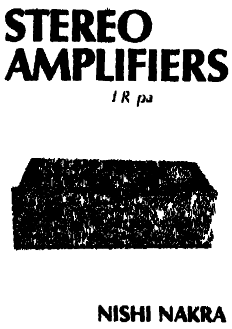
This new Stat 450, Electrostatic Speaker System is ideally suited to reproduction of digital sound, the current state-of-the-art in musical recording. It is a 'hybrid' speaker system that has three electrostatic midrange/tweeter panels and a 25cm bass driver. The bass driver's cone is made from advanced bilayer material Its low distortion, superior transient reproduction and high power capacity make it the perfect match for the electrostatic panels.


ELECTROSTATIC SPEAKER SYSTEM

These electrostatic panels use an extremely light plastic diaphragm to generate sound. The diaphragm is suspended between two specially designed wirewound frames. A high voltage, low current charge is applied to the windings to establish a balanced electrostatic field. The benefit of this type of driver is that the force that moves the diaphragm is evenly applied over its entire surface preventing diaphragm 'break-up' which may cause distortion.

Contact: Penril Corpn., 5520 Randolph Road, Rockville, Maryland 20852, USA

Book Reviews


STEREO AMPLIFIERS

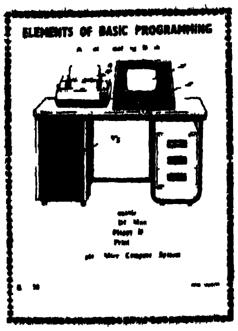
NISHI NAKRA

Stereo Amplifiers: Maintenance and Repair

By Nishi Nakra; published by Tata McGraw-Hill Publishing Company Ltd, New Delhi; pages 112 (18 cm × 24 cm); soft cover.

In recent years, with the advent of transistors and ICs, the world of hi-fi stereo systems has undergone a sea change However, the maintenance and troubleshooting techniques for these systems in this country cannot be said to have kept pace with this drastic development This book aims to bridge this gap by introducing the reader to the troubleshooting techniques in vogue in this field Divided into nine chapters, the book deals with the concept of stereo amplifiers, active semiconductor circuits, theory and design, and practical faults and their remedies in pre-amplifier stages (both capacitor and direct-coupled types) with a large number of tested circuits used in amplifiers of various brands The last chapters cover the details regarding instruments required on a audio test bench, and the etiquette and art of servicing A must for service engineers and technicians and a useful companion for hobbyists and beginners

—D G


ELEMENTS OF BASIC PROGRAMMING

Elements of BASIC Programming

(A Self-Teaching Book)

By R. Ramaswamy; published by R.R. Computer Centre, Madurai; pages 190 (18 cm × 24 cm); soft cover; price: Rs 35.

What with the rapid advances in computer technology and its manifestations in business, industry, and even at homes, knowledge of computer programming has become imperative for a person to keep abreast of times. This book serves to provide the momentum for the reluctant beginner bogged by the myth of complexity of computer programming by simplifying its concepts. The book systematically and meticulously explains the various terminologies that a beginner must know before starting off with the BASIC language. Flowcharts and sample programs are given at appropriate places for purpose of clarity. Any beginner who thoroughly goes through this 'teach-yourself book will not have to attend classes to learn the language

—B Prem

1001 THINGS TO DO WITH YOUR IBM PC

1001 Things to Do with Your IBM PC

By Mark R. Sawusch and Tan A. Summers; published by B.P.B. Publications, Delhi by arrangement with TAB Books Inc., USA; pages 254 (18 cm × 23 cm); soft cover; price: Rs 90.

This book is indispensable for IBM PC-owners And, for those who have run out of ideas as to how to use their PC, here's a gold mine -1001 ingenuine and exciting ways to put the PC to use Various applications, ranging from household record-keeping and budgeting to investment analysis, from game playing and hobby use to scientific, educational and technical applications have been discussed The book contains actual programs, printouts, flowcharts, diagrams and step-by-step instructions for deriving the maximum out of the micro A good source of material for programmers who write games or who like variety The book contains enough ideas to keep you and your PC going for a life time

—B V R

COMPUTER ALGORITHMS

Fundamentals of Computer Algorithms

By Ellis Horowitz and Sartaj Sahni; published by Galgotia Publications, New Delhi; pages 640 (15 cm × 22 cm); hard cover; price: Rs 150.

Each of the 12 chapters of this book is devoted to a fundamental design method with an organised collection of algorithms and analysis techniques in such a way as to make it feasible for use by both graduate and undergraduate students The chapters describe how to devise algorithms, how to express them, how to choose between two alternative algorithms for a given problem, how to validate and analyse them, and how to test and improve a program With several illustrative examples, this book will be a valuable guide for students in computer science and mathematics as well as an important reference book for computer professionals

—B.V.R.

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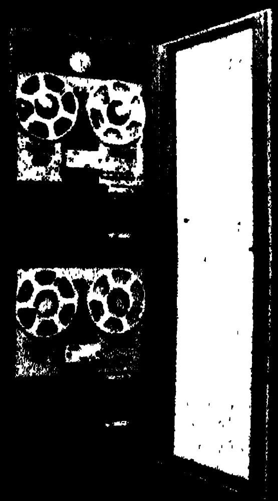

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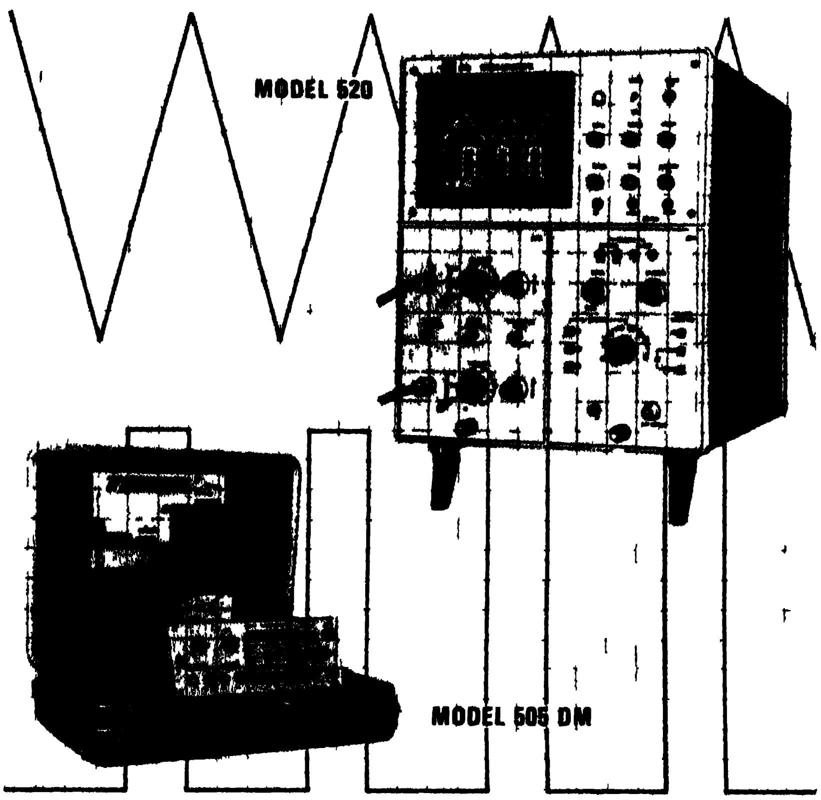

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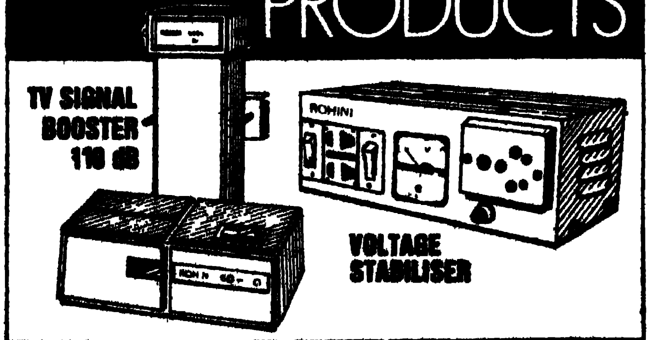

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Dr. D Bhadkamkar Marg, Bombay-400 007 Phone 369495

Company Profiles

Usha Microprocess forges ahead

Usha Microprocess Controls, known for its stress on providing latest computer technology at competitive prices, recently launched two new state-of-the-art computer systems in the Indian market

A microcomputer based on Intel 80286 chip which is 100 per cent compatible with IBM PC AT is the new advanced technology IBM introduced This system is priced very competitively at Rs 140,000 The other new system is a Motorola 68020 VME Unix System V This system is a 32-bit computer for handling large volumes of data at a very high speed meant specially for big corporations and central offices of banks The two systems are the latest in the range of computers the world over

Besides, the company with its subsidiary Usha Computers & Peripherals Ltd offers a number of office automation products which include electronic PABX systems, dot matrix printers, line printers, floppy drives and diskettes, plain paper copiers, electronic telexes, modems and other peripherals Thus, the Usha-RKKR group is all set to offer a complete package for an electronic office of tomorrow.

Acroplast starts production

Acroplast Limited, a unit set up in Rajasthan for manufacturing plastic-moulded cabinets for televisions, commenced commercial production on November 10, 1985 The unit, financed jointly with Rajasthan State Industrial Development and Investment Corporation Limited, has an equity participation to the extent of 20 per cent of the promoter s capital

The company has an installed capacity of 216 000 cabinets per annum and is at present manufacturing cabinets for 30.5cm black-and-white televisions The moulds for the purpose have been imported from the Far East It plans to expand its capacity and start the manufacture of plastic cabinets for stereo systems, portable 51cm colour televisions, telephones, computers, cases for video cassettes and injection-moulded parts [illegible] automobiles in the future. The plants [illegible] this are to be imported from Japan [illegible] necessary moulds from South Korea and Singapore The company has understandings with the leading tool rooms in these countries, who would be developing the required moulds of very good quality using computer-aided equipment The company is also planning to create matching facilities in India, with their assistance

After expansion, the total cost of the project is expected to go up to Rs 25 million from the present Rs 10 million The turnover for the year is expected to be Rs 50 million

Tiger Electronics goes public

Tiger Electronics, set up in technical collaboration with two leading West German firms, has entered the capital market with an issue of 750,000 equity shares of Rs 10 each to raise a working capital of Rs 7 5 million A fully equipped unit for the manufacture of consumer electronics items has been set up at Okhla, New Delhi

The company has already started the production of colour and B&W TV sets in technical collaboration with Loewe, West Germany Under another agreement with Schneider Rundfurwerke, Tiger expects to start the production of VCRs, VCPs, tape recorders, two-in-ones, three-in-ones, electronic toys and personal computers in the near future

The company has assured a maiden dividend of 18 per cent for the first full year's operations ending June 1987 It also expects a turnover of Rs 140 million during this period

Mullard Tubes unit inaugurated

The new manufacturing unit of Mullard Tubes for the production of black-and-white picture tubes was inaugurated recently at Ludhiana by the Punjab chief minister Mr S S Barnala

Promoted by the makers of Texla TV and financed by the Punjab State Industrial Development Corporation and the Punjab Financial Corporation, the company has been set up at the initiative of an NRI Mullard has an approved production capacity of one million picture tubes per annum It will initially manufacture 300,000 tubes a year and expects to achieve full capacity within three years

The company also has plans to diversify into the production of indigenous colour picture tubes by 1989

Norsk Data to make minicomputers

Norsk Data India, a joint venture of Indchem Electronics Ltd and Norsk Data, Norway, will manufacture 16-bit minicomputers for the domestic market The project costing Rs 20 million involves transfer of technology on a continuous basis

The plant, located at Perungudi in Madras, will produce 25 systems per year The first system has already been manufactured and successfully demonstrated The first computer will be marketed by mid-1986

A powerful minicomputer in terms of memory, speed and power, each system will cost about Rs 1 million

Modi Xerox launches desk-top copier

Modi Xerox, a leading name in plain paper copiers, recently launched a small desk-top copier, model 1025 This copier incorporates the reduction-enlargement facility, semi-document feeder and pushbutton copy paper size selection

Originally developed by Fuji Xerox Ltd, the new copier is being manufactured at the company's plant at Rampur Modi Xerox offers a full service maintenance agreement which provides all spare parts, consumables and service labour at a fixed per-copy cost

HB Leasing diversifies into telecom

HB Leasing Finance Company is diversifying into the production of a facsimile data transmission equipment with Canadian technology

The company entered into a technical collaboration last week with Panfax, Canada for producing facsimile data transmission equipment indigenously. The facsimile method employs voice mode digital data transmission method through which pictures and whole documents could be transmitted across the country using a normal telephone line, Also, it requires no additional equipment to be attached to the telephones and the user need not get P and T sanction for employing such machines.

At present such machines are being imported and find application in newspaper production. The indigenous machine would be manufactured in different ranges and would cost between Rs 15,000 to Rs 90,000 for one system.

The company is also negotiating with some Japanese companies for acquiring technology for the manufacture of large sized machines.

BPL-Sanyo unit commences production

BPL-Sanyo Components Pvt Ltd, a joint venture of BPL India and Sanyo, Japan, recently began production at its plant in Bangalore. This is the first factory in the country to manufacture components for colour TV sets.

The components under production are deflection yokes, flyback transformers and electronic tuners for CTVs. The company expects to save a large amount of foreign exchange with the introduction of such indigenous CTV components.

Mini videotorium from Super-Vu

Super-Vu International has launched its latest videotorium, a one-piece TV projection system. Occupying the space of a standard 50cm TV and costing less than 67.5cm TV, the videotorium-mini gives seven times larger image than the 50cm TV. There is no need to buy a new TV since everything is in-built. However, one can utilise a portable TV also with this system. Owning this system amounts virtually to having a mini theatre at home.

The cabinet made with the best quality laminated plywood with a sleek finish blends with any decor The upper portion houses a folding projector with place for a portable 35cm colour TV and uses front face aluminised vacuum coated mirror to reflect image on 125cm hi-gain front projection screen. The mirror folds, closing the set when not in use. Lower portion of the cabinet has enough space to house the VCR and a few video cassettes. Fitted with smooth moving swivelling castors, the entire unit can be easily moved around. Its hi-gain screen works very well under high ambient lights.

Khandelwal Herrmann poised for growth

Khandelwal Herrmann Electronics Limited is presently one of the world's leading manufacturers of high voltage TV rectifiers. Every black-and-white TV set made in India uses KHEL rectifiers as original equipment. The high quality of KHEL s products is assured due to its technical collaboration with AEG Telefunken. West Germany.

It is anticipated that the demand for black-and-white TV sets will get an appreciable boost in view of the hike in excise duty from Rs 900 to Rs 1500 on colour TV sets with screen size exceeding 36 cm, imposed in the current year's budget.

The continued growth of black-and-white TV industry is expected to result in doubling the turnover of KHEL from Rs 25 million in 1985 to Rs 50 million in 1986. KHEL's turnover for the first two months of this year has been around Rs 5 million which is double of last year's production for the same period. This trend is expected to receive an impetus in view of the growing demand for black-and-white TVs.

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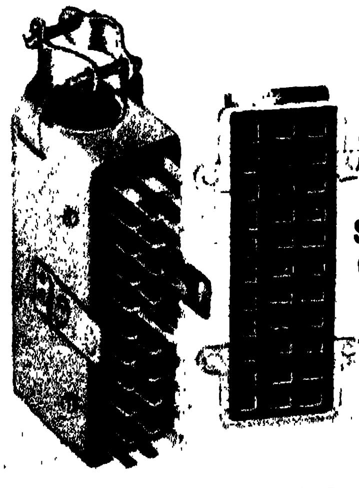

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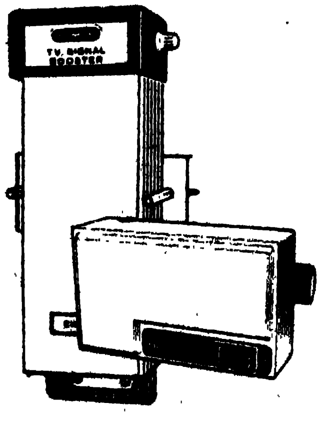

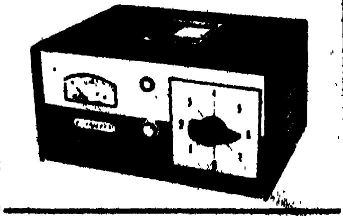

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Facts & Figures

LICENCES AND LETTERS OF INTENT

The following licences and letters of intent were issued to electronics firms under the Industries (Development & Regulation) Act, 1951 during the month of November 1985

Name & Address of the Applicant and Location of the Undertaking	*Date & Type of Licence*	*Article*	*Quantity per Annum*
(1)	*(2)*	*(3)*	*(4)*
LICENCES			
Indian Telephone Industries Ltd 16 Museum Road Bangalore 560001 (Distt Bangalore-Karnataka)	6 11 85 (SE)	Telephone instruments (new technology)	500,000 nos out of which a minimum of 200,000 nos p a of new technology
Uptron Digital Systems Ltd Shri Pratap Bhavan Newal Kishore Road Lucknow 226001 (Distt Lucknow-Uttar Pradesh)	6 11 85 (NA)	CRT data display terminals	2000 nos
Uptron Digital Systems Ltd Shri Pratap Bhavan Newal Kishore Road Lucknow 226001 (Distt Lucknow-Uttar Pradesh)	6 11 85 (NA)	Minicomputer/micro-processor based systems	Rs 60 million
Media Computer Products Pvt Ltd 64 Industrial Area Umbergaon 396171 (Gandhinagar-Gujarat)	8 11 85 (NU)	1 Computer tapes 2 Floppy discs	1100 MRM (1 27cm width) 2 million nos
Eastern Circuits Ltd E-1/212 Arera Colony Bhopal (Distt Raigarh-Madhya Pradesh)	14 11 85 (NU)	Printed circuit boards	1 75 sq.m
Viewtron Electronics Pvt Ltd 303-304 Rattan Jyoti 18 Rajendra Palace New Delhi 110008 (Distt Ghaziabad-Uttar Pradesh)	25 11 85 (NU)	1 CTV receivers 2 Black-and-white TV receivers	50,000 nos 20,000 nos
Gujarat Semiconductors Pvt Ltd 57-59 GIDC Estate Visnagar 384315 (Distt Mehsana-Gujarat)	25 11.85 (SE)	Silicon junction diodes (below 30 amps)	10 million nos (after expn)
LETTERS OF INTENT			
Col S K.S Mudaliar (Retd) Chairman, Indo-American Dev Corpn (IADC)-NRI Group 6509 Greentree Road Methesad, Maryland 20817 USA (Any backward distt in (Andhra Pradesh)	4 11 85 (NU)	Photovoltaic cells, modules and systems	3 MW
Digital Innovations Pvt Ltd 46/B Gautamnagar Race Course Road Baroda 390007 (Distt Baroda-Gujarat)	7 11 85 (NU)	Development of computer software and services	
Methodex Systems Pvt Ltd 607-8 Meghdoot 94 Nehru Place New Delhi 110019 (Distt Dhar-Madhya Pradesh)	8 11 85 (NU)	Photovoltaic modules and systems	1000 kW
Ador Computers Pvt Ltd Advani Chambers, Top Floor Sir P.M Road, Fort Bombay 400001 (Distt Pune Maharashtra)	8 11 85 (NU)	Mini/microprocessor based systems	Rs 60 million
Continental Device India Ltd C-120 Naraina Industrial Area New Delhi 110028 (Distt Gurgaon Haryana)	8 11.85 (NU)	Minicomputer/micro-processor based systems	Rs 200 million
Parmod Kumar Aggarwal 49A Presidency Society N S Road No. 7 J V P Scheme, Juhu Bombay 400049 (Distt Lonavala-Maharashtra)	8 11 85 (NU)	Floppy disc drives and serial printers	Rs 100 million
Sanjay Toshniwal 69A Mittal Chambers, Nariman Point Bombay 400021 (Distt Vidharba-Maharashtra)	8 11.85 (NU)	Computer peripherals and floppy disc drives	Rs 60 million
Debikay Information Technology Ltd B-146 Soami Nagar, Outer Ring Road New Delhi 110017 (Distt Ghaziabad-Uttar Pradesh)	8 11 85 (NA)	Mini/microprocessor based systems	Rs 50 million
Bihar State Electronics Dev Corpn Ltd Udoyog Bhawan, 2nd Floor East Gandhi Maidan Patna 800004 (Any backward area in Bihar)	8 11 85 (NU)	Facsimile equipment	500 nos
Milan Electronics Pvt Ltd H-22 Kailash Colony New Delhi 110040 (Distt Ghaziabad-Uttar Pradesh)	8 11.85 (NU)	Minicomputer/micro-processor based systems	Rs 95 million
Murphy India Ltd Eastern Express Highway P O Box No 201, Naupada Thana 400602 (Gandhinagar-Gujarat)	8 11.85 (NA)	Facsimile equipment	2000 nos
Suresh A Keshwani Feltham House, Ground Floor 10 J M Heredia Marg Ballard Estate Bombay 400038 (Distt Bombay-Maharashtra)	8 11.85 (NU)	Minicomputer/micro-processor based systems	Rs 200 million
Danfoss (India) Ltd 706-707 Surya Kiran 19 K G Marg New Delhi 110001 (Distt Ghaziabad-Uttar Pradesh)	8 11.85 (NA)	Photovoltaic modules and systems with accessories	600 kW
Technology Parks Ltd 78 Janpath, 1st Floor New Delhi 110001 (Distt Ghaziabad-Uttar Pradesh)	8.11.85 (NU)	Solar photovoltaic modules	5 MWP
Peico Electronics & Electricals Ltd Shivsagar Estate, Block-A Dr Annie Besant Road, Worli Bombay 400018 (Distt Pune-Maharashtra)	8 11.85 (NA)	Single-sided printed circuit boards	30,000 sq.m.
Kartar Singh Thakral C/o Dr N L. Hingorani R.J. Consultants Pvt Ltd 3A Meher House, 1st Floor Cawasji Patel Street, Fort Bombay 400001 (Any permissible location in Karnataka)	14.11 85 (NU)	1 CTV receivers 2. Black-and-white TV receivers 3. Closed circuit TV sets	50,000 nos. 100,000 nos. 1000 nos.

(1)	(2)	(3)	(4)
Vishy Harihara 28 Birley Road London N-200 EZ UK (Distt Ranga Reddy-Andhra Pradesh)	14 11 85 (NU)	Minicomputer/micro-processor based systems	Rs 200 million
Bipin Kumar Agarwal 3003 Skypark, Houston Texas 77082 USA (Distt Dehradun-Uttar Pradesh)	14.11 85 (NU)	Minicomputer/micro-processor based systems	Rs 200 million
A B Controls Ltd C-II, Site IV Industrial Area, Sahibabad Ghaziabad (Distt Ghaziabad-Uttar Pradesh)	14.11 85 (NA)	Uninterruptible power supply systems	Rs 30 million in terms of ex-factory turnover value
J K Synthetics Ltd Kamala Tower Kanpur (Backward region in Himachal Pradesh)	14.11.85 (NU)	Facsimile systems and allied equipment	2000 nos
Garware Plastics and Polyster Ltd 50A Swami Nityanand Marg Vile Parley (E) Western Express Highway Bombay 400057 (Distt Nasik-Maharashtra)	14 11 85 (NA)	Floppy discs	1 million pcs
Modi Xerox Ltd Modipuram 250110 Meerut (Distt Rampur-Uttar Pradesh)	14 11 85 (NA)	Minicomputer/micro-processor based systems	Rs 300 million
Solid State Devices India Ltd 6-2-14 Raj Bhavan Hyderabad 500004 (Distt Medak-Andhra Pradesh)	20 11 85 (NA)	Photovoltaic cells	2 MW
Electronics Corpn of India Ltd SCIL Post Office Hyderabad 500762 (Distt Ranga Reddy-Andhra Pradesh)	20.11 85 (SE)	Facsimile transreceivers	1500 nos. (after expn)
Ravi C Krishnan C-128 Sarvodaya Enclave Aurbindo Marg New Delhi 110017 (Haryana)	22 11 85 (NU)	Amorphous silicon photovoltaic cells, panels, modules and connected systems	3 MW
Indian Computer Software Co Ltd 806 Siddhartha, 96 Nehru Place New Delhi 110019 (Any permissible area outside the municipal limits of Madras city)	22.11 85 (NU)	Dot matrix printers and CRT data/graphic display monitor terminals	Rs 60 million
Madhya Pradesh State Electronics Dev Corpn Ltd E-1/154 Arera Colony Bhopal 462016 (Distt Dhar-Madhya Pradesh)	22 11.85 (NU)	Minicomputer/micro-processor based systems	Rs 140 million
The Orissa State Electronics Dev Corpn Ltd A-171 Sahidnagar Bhubaneswar 751007 (Distt Puri-Orissa)	22.11 85 (NU)	Multichannel access rural radio telephone systems	Rs 30 million ex-factory turnover
Amit Mital C-1/54 Safdarjang Development Area New Delhi 110016 (Distt Ghaziabad-Uttar Pradesh)	22.11.85 (NU)	Digital facsimile transreceivers	2000 nos.
Bharat Electronics Ltd 29/4 Trade Centre Race Course Road Bangalore 560001 (Distt Bangalore-Karnataka)	29.11 85 (SE)	Electron guns for black-and-white TV picture tubes	3 million nos. (after expn)
Aptek Computers Pvt Ltd 113 Jolly Maker Chambers No. 2 Nariman Point Bombay 400021 (Distt Baroda-Gujarat)	29.11.85 (NU)	Computer peripherals 1. Dot matrix printers 2. Winchester drives 3. Floppy disc drives	Rs 100 million
Orissa Computer Application Centre 21 Satyanagar Bhubaneshwar 751007 (Distt Puri-Orissa)	29 11.85 (NU)	Software packages for computer applications	Rs 60 million

LICENCES AND LETTERS OF INTENT CANCELLED

Name of Undertaking/Location	Date	Article
LICENCES		
Vijai Electronics Pvt Ltd Hyderabad (Andhra Pradesh)	29 3 85 Revoked	CTV receivers
LETTERS OF INTENT		
A Ramachandra Raju C/o Dr D Krishna Kumar Pujagutta, Hyderabad (Andhra Pradesh)	2 12 83 Cancelled	CTV receivers
Sikkim Industrial Dev and Inv. Corpn Ltd Gangtok (Sikkim)	16 7 84 Cancelled	CTV receivers
Vijai Electronics Pvt Ltd Hyderabad (Andhra Pradesh)	24 4 85 Cancelled	Black and-white TV receivers

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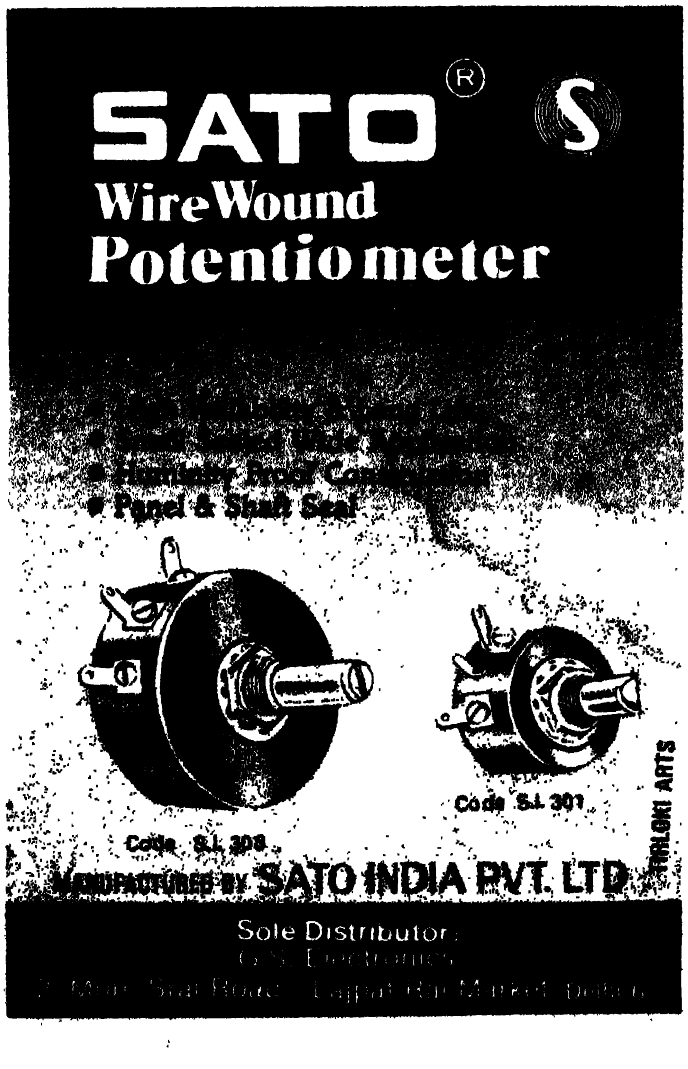
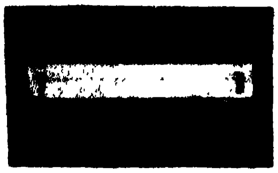
—Editor



PE PRODUCTS



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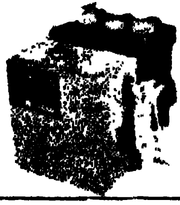

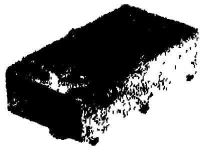

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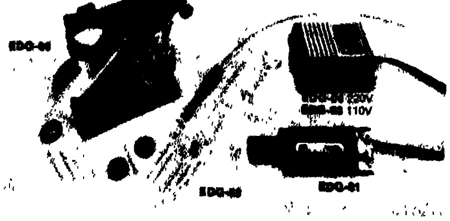

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INCHES	MM
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032—.048	0 8—1.2
.052—.067	1.3—1.7
.071—.087	1.8—2.2
091—107	2 3—2.7
111—.126	2 8—3.2

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EDG-10	Grinder Accessories Kit
EDG-11	Cut-Off Wheels
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1	Mounted Nylon Brush
2	Cut-off Wheels
1	Finger Guard
6	Collets

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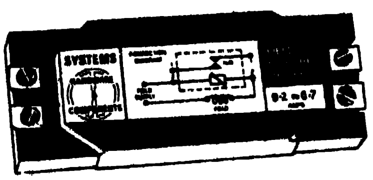

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53	Musical Door Bell	6	65
54	Electronic Horn for Car	5	75
55	Walkman Disco Light	2	30
56	IC Disco Light Star Figure	7	60
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58	Light Dimmer	3	75
59	Musical Door Bell (16 different sounds)	15	140
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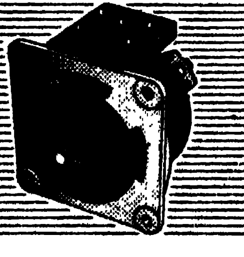

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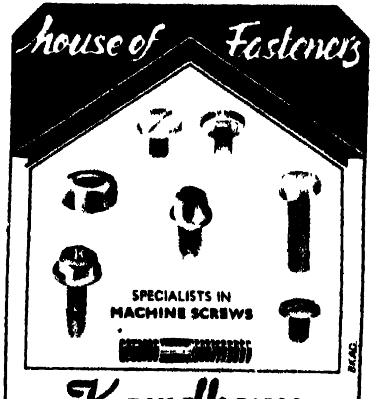

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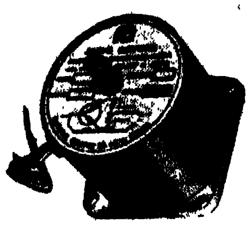

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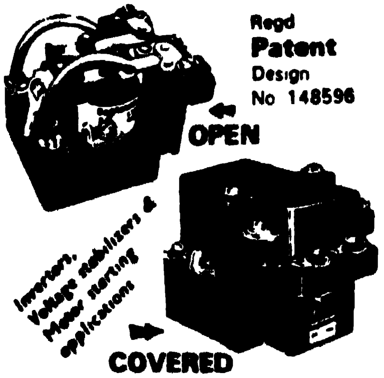
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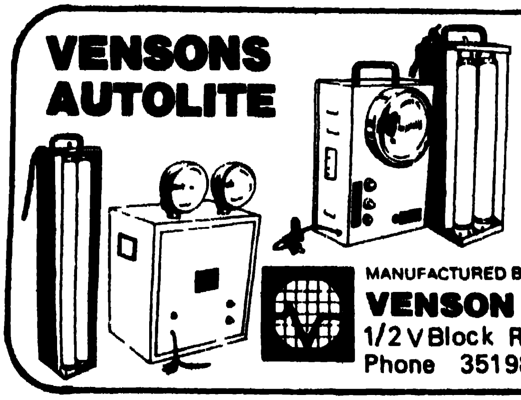

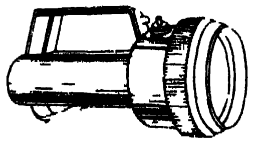

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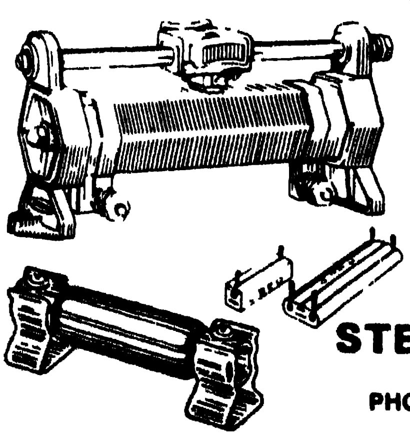

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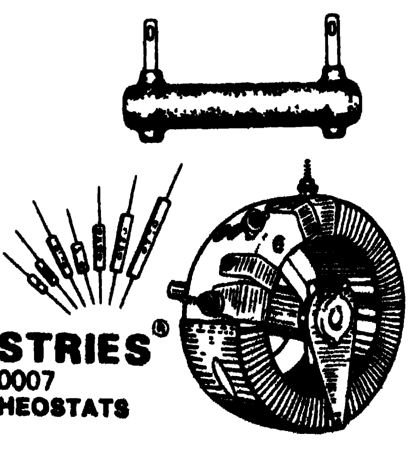

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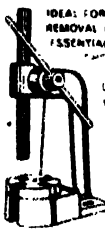

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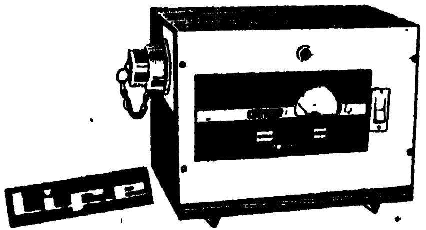

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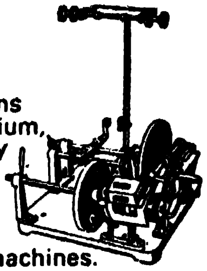

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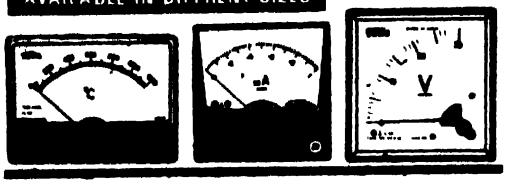

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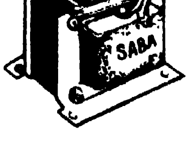

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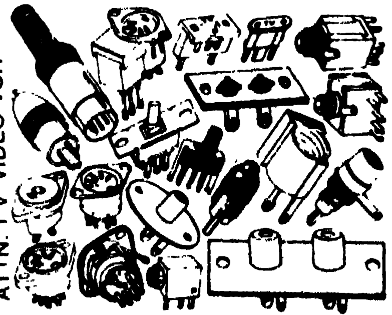

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Advertisers' Index

ASE Ltd (Systronics) 105
Afco Industrial & Chemical 107
Alfa Products 64
Allied Publishers 64
Aradhna Electronics 8, 96
Arun Electronics 98
Associated Electrical Agencies 7
Auto Controls 25
B R Enterprises 64
BPL India 53
Bajaj Electricals 42
Bakubhai Ambalal 72
Balaji Engineering 113
Brisk Electro Sales 62
CTR Manufacturing 44
Component Technique 62
Consultancy Bureau 32
Crescent Agencies 87
Cycl-O Computers 96
Dobikay 20
Dominion Radios 64, 96
Electron 95
Electronic Instruments & Controls 107
Electronics Corporation of Tamilnadu 45
Elnova 19
Essen Deinki 69
Geeta Monitors 76
Goa Resistors 98
Hyderabad Connectronics 6
ITT, West Germany IV Cover
Inde Associates 9, 12
Integrated Electronics 78
J J Electronics 51
Jetking 31
Kadimi International 52
Kusum Sales 96
Kwality Electricals 32
Labgear India 8
Leader, Japan 73
Leader Electronics 90
Masibus 8, 98
Mecc Instruments 33
Micromax 76
Motwane 63
Murugappa Electronics 75, 77
Neotronics International 97
Nippon Devices 32
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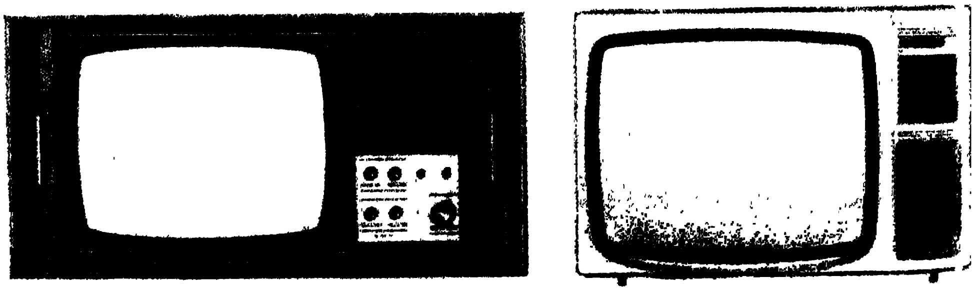

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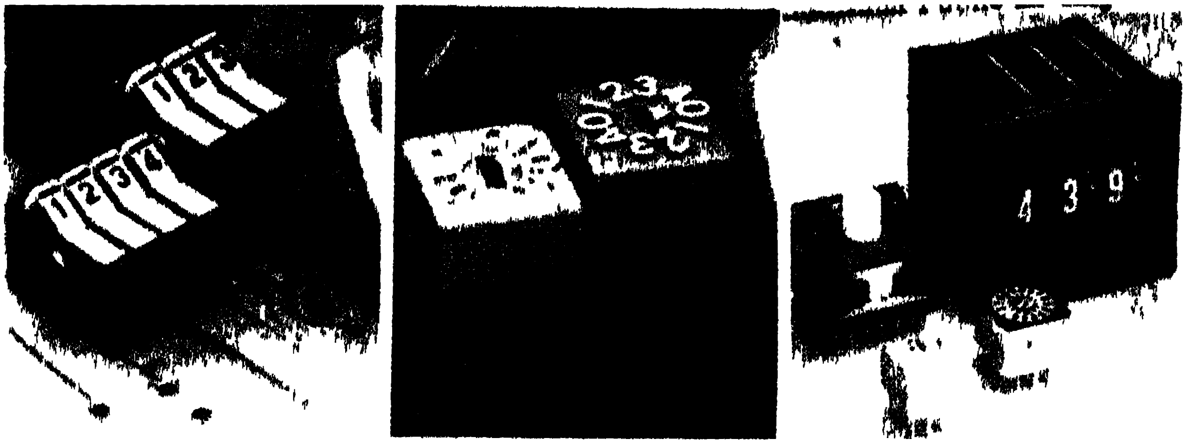

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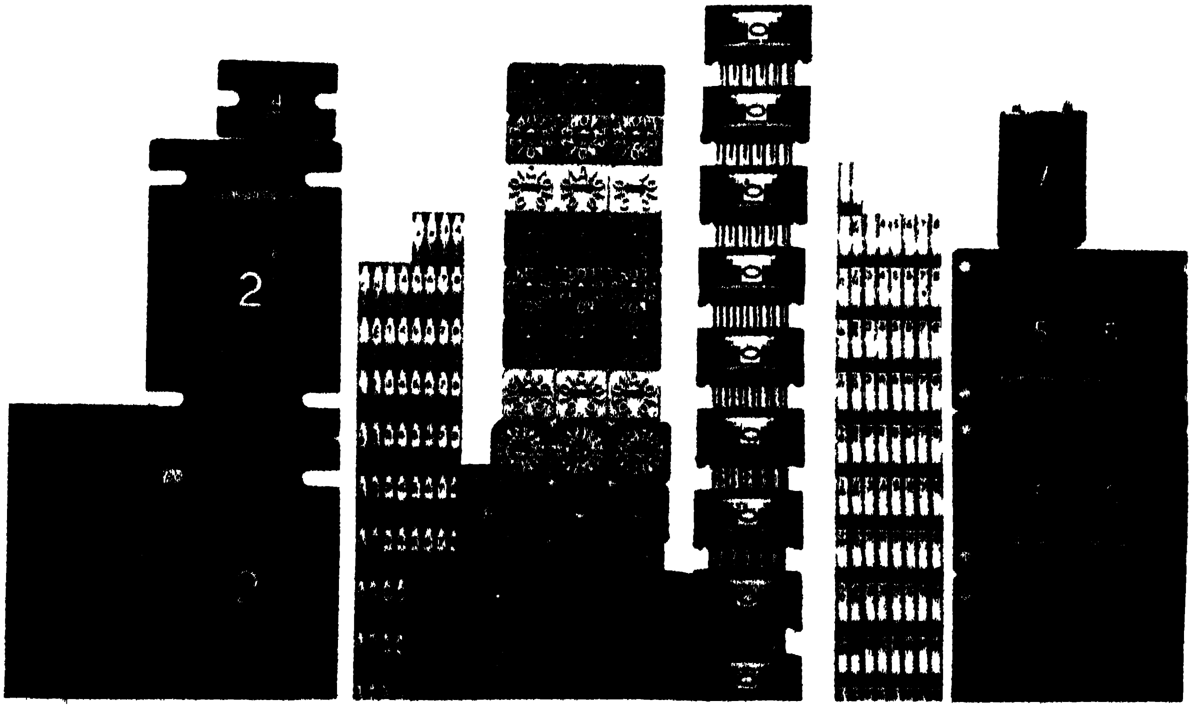

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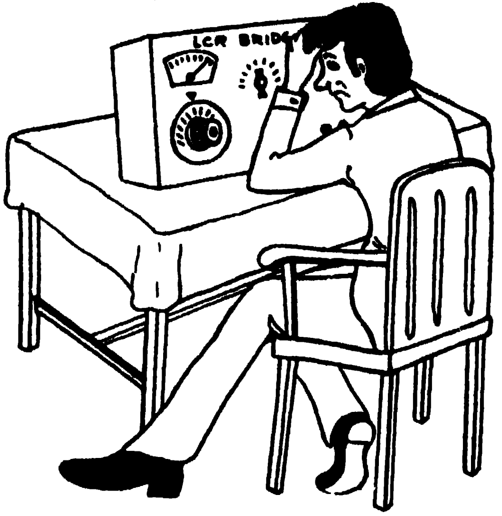

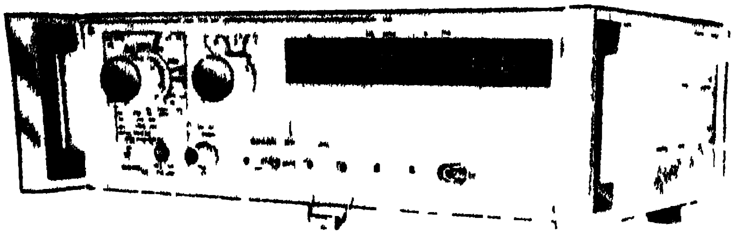

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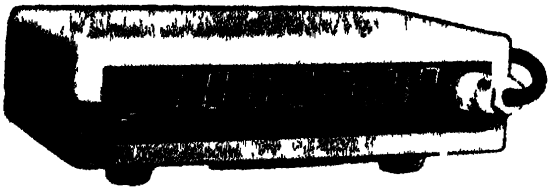

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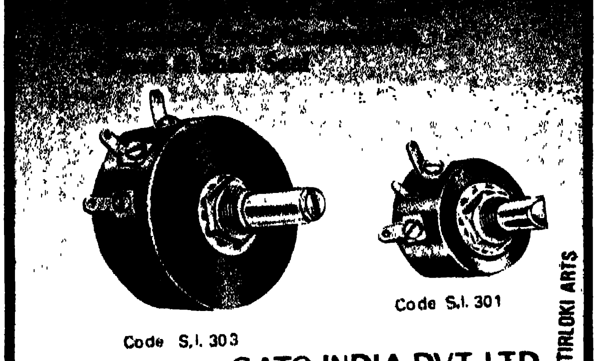

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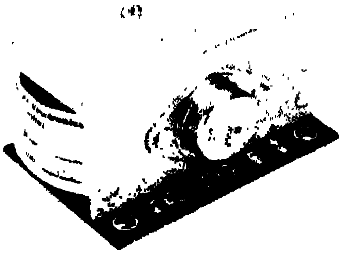

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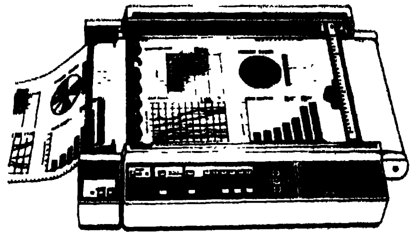

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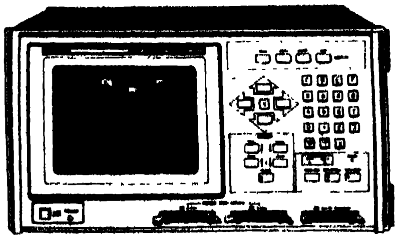

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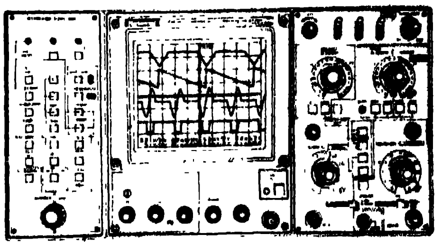

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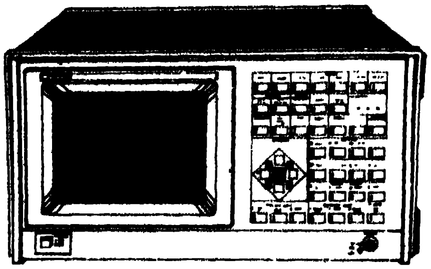

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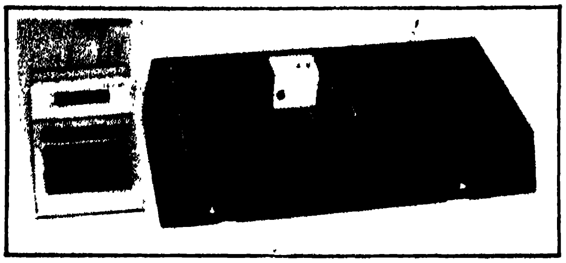

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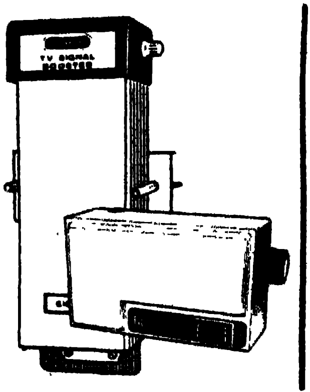

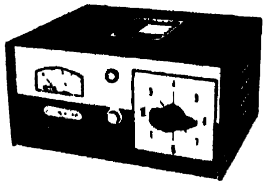

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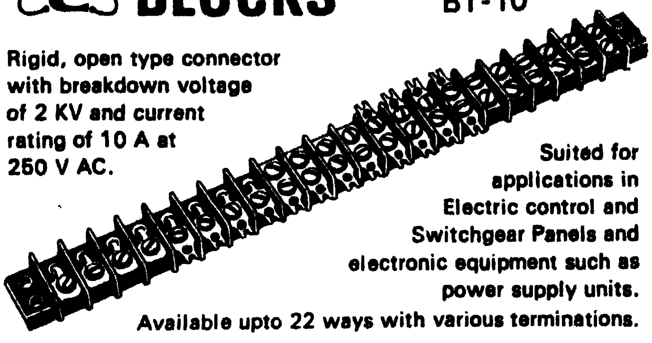

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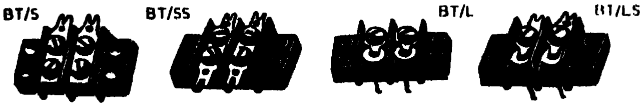

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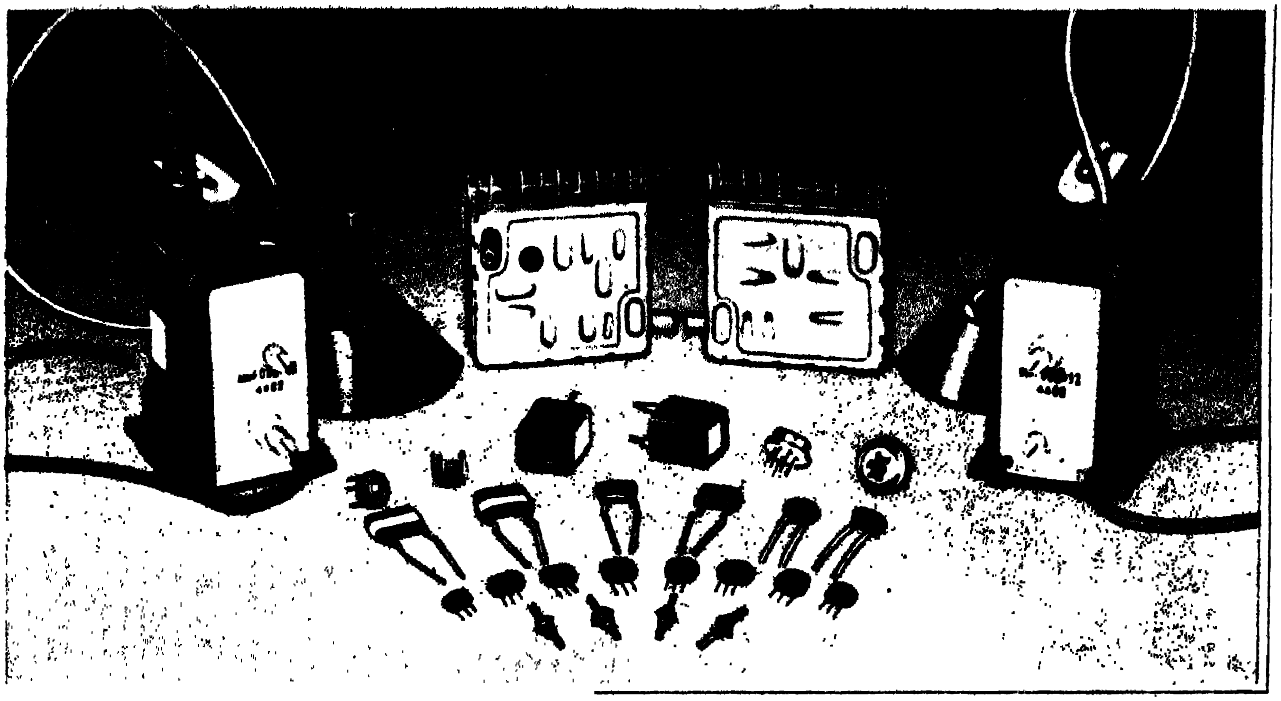

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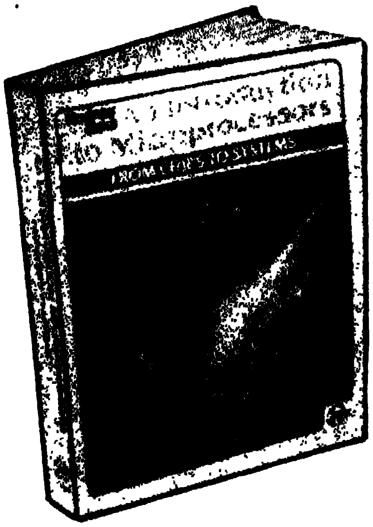

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FROM CHIPS TO SYSTEMS

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Are you intrigued by the mystery and power of microprocessors? This beautifully illustrated edition of a SYBEX bestseller takes you on a fast-paced adventure through the fundamental concepts and inner workings of a microcomputer All aspects of microprocessors and related components are described in easy-to-understand terms internal operation, memories, peripheral chips, system interconnect, microprocessor applications, programming, interfacing and system development

This book is written for everyone who wants to understand how a microprocessor operates and how a complete system is assembled from chips In particular, it is an important resource for students, scientists, and engineers, as well as the nontechnical reader. Surprisingly, no preliminary knowledge of computer or microprocessor technology is needed to understand this book The concepts are carefully defined, each in turn, and the next is presented in a simple and progressive way

The information presented is applicable to any microprocessor although many specific examples are given You are introduced to concepts and design principles common to all microprocessors You are given the standard rules of design and shown how they apply to various microprocessors You are shown both the differences between various microprocessors and the advantages and disadvantages of specific microprocessors

This book is organised to introduce you quickly and effectively to the inner workings of a microprocessor It will help you understand how a microprocessor works, even if you have had no prior experience with electronics

Its chapter provides you the basic definition to understand microprocessor, takes you inside the microprocessors, examines the other components that make up a complete system from the memory chips, advantages and disadvantages of the various microprocessors available, how to put together a system easily and rapidly, main application areas for microprocessor connecting the system to the outside world and programming it (interfacing techniques, microprocessor programming assembly and high-level programming), techniques necessary for connecting the main input/output devices and peripherals. basic definition and techniques for programming microprocessor, resources available in assembly language and survey high level language tools available for efficiently developing a system and also forecasts future developments

Microprocessor technology has beocme an essential component of the industrial world today It is the author's contention that it is possible to learn about microprocessors in a short time This book represents a step in that direction

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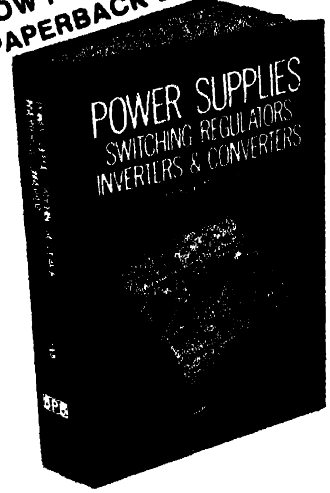

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CONTENTS

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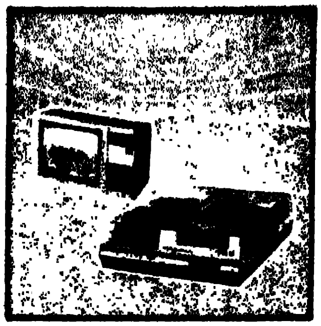
Cable Television



24 Cable television is becoming increasingly popular as a means of entertainment, even in areas served by the normal TV transmissions. The manifold desirable features offered by 'cablecasting', even at extra cost to the viewers, make it a more attractive alternative. The various aspects of cable television are highlighted in this article.

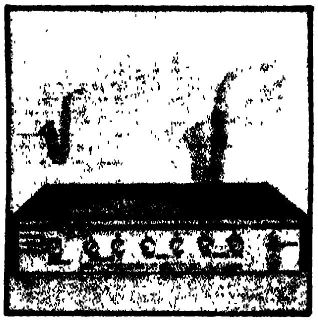
—R.R. Warrier

Behind the Portable Power Sources

68 The power supplies of electronic gadgets using LSI and VLSI state-of-the-art have to be small enough to be portable without being bulky, yet powerful enough to operate the device adequately. This article describes such portable power sources required specially for the miniature electronic devices.

—A.V. Jacob

120W + 120W Stereo Amplifier



78 Here is an audio project which will be welcomed by all hobbyists on the look-out for a powerful stereo amplifier. This 120W + 120W stereo amplifier is particularly suited for use in auditoria or for music concerts where the area which the amplifier must cover is large.

—C. Sanjay

24 Cable Television
—R.R. Warrier

33 A Profile of Electronics Production During 1985
—Based on DoE Annual Report

46 Multiple Program Timer Using Sinclair Micro
—Ajay Chikersal

55 Comparative Study of Computer Languages: Part XI
—R. Ramaswamy

61 Characteristics of Fixed Satellite Service: Part I
—Based on an ITU Report

68 Behind the Portable Power Sources: Part I
—A.V. Jacob

78 120W + 120W Stereo Amplifier
—C. Sanjay

87 Video Car-Racing Game
—Tarun Kumar Tripathy

FEATURES

13 Letters
17 What's New
43 Computer Corner
51 Electroons
46, 78, 87 Construction
95 Circuit Ideas
99 Product Profiles
103 Book Reviews
106 Company Profiles
108 Facts & Figures
111 Electronics Mart

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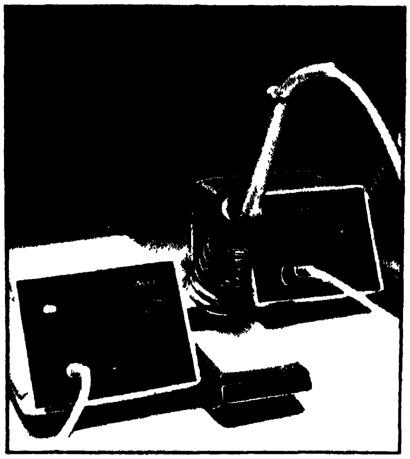

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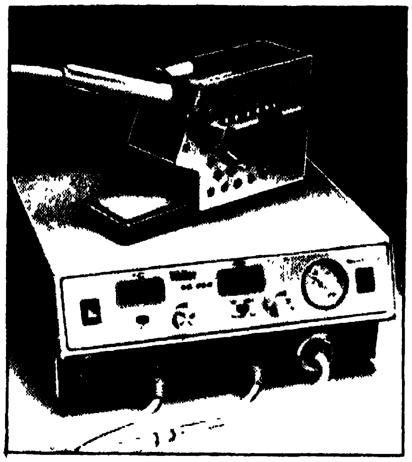
Weller Heat-a Print station is for soldering and desoldering of hybrid circuits.



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KAVERI

Programmable Volume Control

The 'Programmable Volume Control' circuit in November issue is alright, but the same effect can be achieved by using a 10-way thumbwheel switch in place of the BCD type The thumbwheel switch can take the place of the transistor switches directly. This will eliminate IC 7442, ten transistors, one zener diode, 15 resistors, a PCB and a number of interconnecting wires.

P. MARATHEY
Bombay

□ 'Programmable Volume Control' is really a very interesting idea, but it has the following limitations·

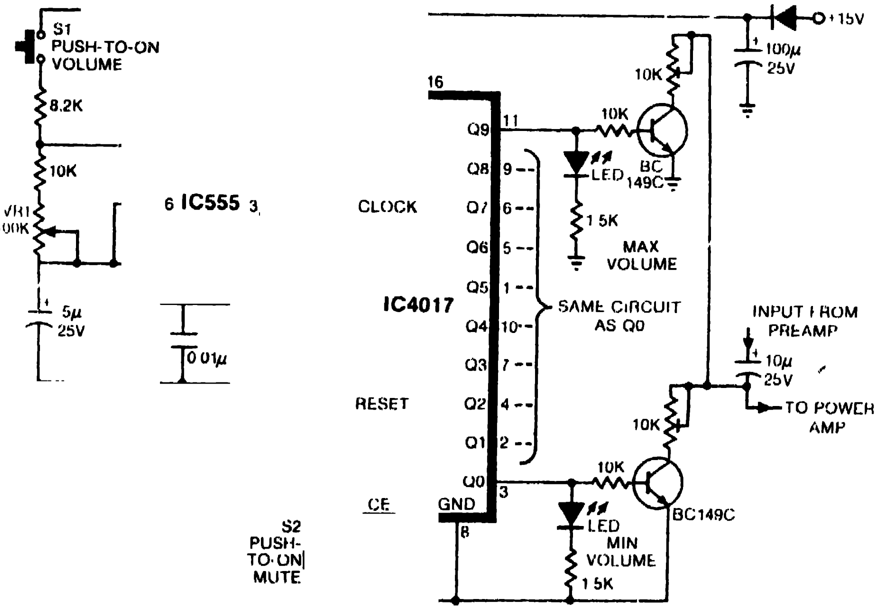
(a) Thumbwheel switch is required to control the volume;

(b) It has to memorise the truth table,

(c) We cannot see the visual indication of the volume; and

(d) 5V regulated power supply is required

These problems can be solved with an additional facility such as a mute switch or we can say fast set to '0' volume. Only two push-to-on type switches are required (as shown in Fig.) to control the volume.



We can mount the programmable volume control on front panel with visual indication

A.S. BAJWA
Kapurthala

□ I am sorry to mention that the standard of EFY has come down mainly due to the publication of half-baked circuits like this one.

The input to the amplifier is directly taken from the output of the preamplifier. If the output of the preamplifier has a sufficiently low output impedance, the signal would hardly get attenuated since the circuit effectively comes only in parallel to the preamplifier's output. The circuit would work only with a low quality preamplifier which has a relatively high output impedance.

Also, I object strongly to the use of npn bipolar transistors as the switching elements The audio signal at the collectors of T1 to T10 would be an AC signal However, an npn transistor would conduct only when the collector is at a positive voltage with respect to the emitter. This means that the positive half cycles of the audio signal would be attenuated while the negative half cycles would be passed on unattenuated, thus resulting in severe distortion of the output signal Even when the collector is positive, a transistor needs saturation voltage of several tens of millivolts before any significant conduction begins. This also means a non-linear attenuation of the input signal A linear characteristic is only possible through an FET, although it is considerably more expensive than an npn transistor

I also fail to understand how a value of 47k could be used for R11 with a supply voltage of 9V. The current through the 47k resistor would be insufficient to bias the zener diode, let alone the circuit R11 may be changed to 270 ohms to keep the zener current at a reasonable level.

R. SHANKAR
Madras

The author, Mr Bidyut Chakraborty, replies: The method described by J.P. Marathey will surely perform the same function but the disadvantage of using a 10-way switch alone is that it produces switching noise. Thus audible noise will be generated from the speaker while changing switch positions.

Mr A.S Bajwa has indeed suggested a good modification to my circuit idea. Now one can easily instal it inside a radio, TV, cassette recorder, amplifier or any other audio equipment. However, the circuit described by me is easy to interface with a microcomputer kit.

I am grateful to Mr R. Shankar for his keen observation of my circuit idea. At the same time I disregard the charge that the standard of EFY has come down due to publication of the circuit The circuit has surely got some novelty value and this type of circuit has rarely appeared in EFY. Moreover, the circuit has inspired several people to think of new circuit ideas.

In the original circuit diagram sent by me, there was a resistance in series with the input coupling capacitor which has been omitted in the published circuit Had this resistance been in the circuit, the first problem pointed out by Mr R Shankar could have been avoided

Again, the value of R11 has been wrongly published in the text as 47 kilohms, in the original manuscript, its value was 47 ohms

Regarding Mr Shankar s second problem, I would say that the output of the circuit is assumed to be directly coupled with the amplifier's input stage and from there the circuit derives DC voltage to keep the transistors in the operating state throughout an AC signal But if one wishes to use a coupling capacitor at the output, one must provide a separate biasing circuit to keep the collector voltage of the transistors reasonably above ground

Since transistors have been used as switching elements in the circuit, there always exists the problem of non-linearity, but that is hardly audible One may use FET switches to get rid of this problem but the circuit will surely become costlier

Correct Your Hourly Chime

I am regular reader of EFY magazine since 1980 Recently I have added the hourly chime circuit, which was published in May 1985 issue, to my digital clock

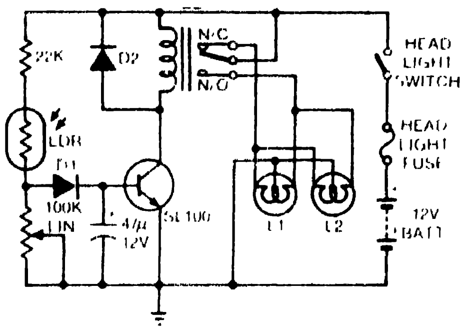
There is one serious mistake in the PCB layout. Pin number 4 of IC 7404 is wrongly connected to pin number 8 of the same IC, which is the output of the unused inverter gate, and which is always in '0 state since its input is open. After disconnecting this wrong connection the circuit started working satisfactorily.

T.K Thiyagarajan
Bombay

Electronic Auto Dipper

Mr Hindocha's circuit in Sept. '85 issue works beautifully, but only after the following modifications in the lamp circuit.

The power supply should be fed into the moving contact of the relay. The N/C contact should then be connected with the main beam filament of the N/O contact with the dipper beam filament of each head lamp In Mr Hindocha's circuit there would be no power supply available to lamp L1 when the relay is energised to make the N/O contact.



The circuit also operates without the power transistor 2N3055 (a saving) The LDR can be mounted on a small bracket screwed to the right head lamp's mounting screw after wrapping the LDR neatly in a single layer of polythene sheet

Maj G MATHUR
Darjeeling

Excise on Digital Multimeters

Due to the tough competition with imported digital multimeters (DMMs) available in the market at throwaway prices, the position of indigenous manufacturers of hand-held DMMs has become pitiable

But how are the imported DMMs offered openly by the dealers? Are they smuggled? Does the import policy permit their import and sale in open market? Our understanding of the import policy is that it is not possible legally

We have informed and approached all government bodies regarding this matter but did not find any encouraging response As far as the Directorate of Revenue Intelligence is concerned, this case seems to be very small for them. Similarly the customs people say that they can help us only if we give them information about the goods arrival

So, the indigenous manufacturer finds himself in an embarrassing situation should he continue his manufacturing activities or terminate the services of his employees and start smuggling?

We suggest abolition of excise duty on DMMs valued up to Rs 1550 (as the smuggled DMMs do not attract excise or customs duty). Even if the sales of foreign DMMs are claimed to be legal, the duty and CVD might have been charged on a rock-bottom, under-invoiced value only. Whereas the Indian manufacturer imports components by paying full customs duty and CVD. The indigenous components and raw materials also attract excise duty.

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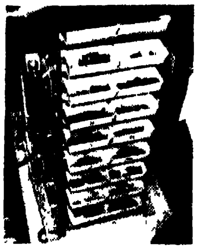

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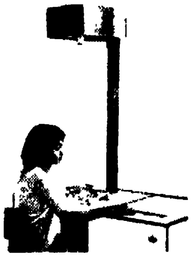

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IN INDIA....

Price hike of CTVs

In the central budget proposals for 1986-87, the excise duty on colour television (CTV) receivers of screen size exceeding 36cm has been increased by Rs 600.

A quick survey of prices made thereafter indicates that the prices of some CTV sets have gone up approximately by Rs 660 to Rs 700 in Delhi. The rates of sales tax and other local taxes differ from state to state. The increase in market prices in different states would broadly vary accordingly.

There has been no increase in the excise duty on B&W TV sets of screen size exceeding 36cm Also, the B&W TV sets of screen size not exceeding 36cm continue to be exempt from excise duty—except for the additional excise duty of Rs 100, levied on all TV sets, in lieu of the abolition of the annual licence fee for TV broadcast reception.

Manufacture of indigenous TV sets

Thirteen units in the public sector and 190 units in the private sector have reported manufacture of TV sets. Their annual production, during 1985, was 237,000 and 2.223 million sets respectively.

Eleven units in the public sector and 78 units in the private sector have reported manufacture of CTV sets. Their annual production, during 1985, was 119,000 and 541,000 sets respectively.

The colour TV policy announced by the government on February 25, 1983 stipulated that all sectors of the industry except foreign equity companies could participate in the manufacture of CTVs. Subsequently, companies with foreign equity not exceeding 40 per cent were also allowed to participate in this industry subject to certain conditions.

The government had received representations from TV manufacturers against the entry of multinationals and foreign equity holding companies in this industry. The current policy expects to take better care of consumer interest through improvement in quality and technology and should not affect the industry since the demand for TV receivers is increasing.

Production of watches on the rise

A total of 270,722 electronic watches were produced in India during the year 1985, with HMT, Bangalore accounting for nearly two-thirds of the total production.

HMT and Allwyn, Hyderabad, accounted for a major chunk of the output producing 163,000 and 94,002 watches respectively There are only three other companies making electronic watches in India They are Electronics Corporation of Tamilnadu, Keltron Crystals Ltd, Cannanore, and RIICO, Ajmer

The Semiconductor Complex Ltd (SCL) has also been allowed to manufacture and sell low-cost DEW (digital electronic watch) modules to DEW assemblers, both in the state public sector and small-scale units as a measure for promoting the electronic watch industry. Small-scale units may also be permitted to sell low-cost DEWs or other DEW module-based products directly in the market. If the demand outstrips the capacity of SCL, a second unit in the private sector will be permitted to manufacture these modules.

Licensing for VCRs and microwave ovens

In 1985, the government had invited composite applications for the indigenous manufacture of VCRs/VCPs and microwave ovens by January 24, 1986. In response, 65 applications have been received for the manufacture of VCRs/VCPs and 44 for the manufacture of microwave ovens. The applications are at present being scrutinised by an inter-departmental task force

The government proposes to issue industrial licences for the manufacture of VCRs and microwave ovens only to such companies as are prepared to commit sizeable investments for suitable vertical integration, with an accelerated phased manufacturing programme; and which have the requisite in-built capacity to keep pace with the changing technology.

The projected demand for VCRs in 1989-90 is estimated at 500,000 systems and for microwave ovens it is estimated at 30,000. The demand, expected to be met indigenously, will affect considerable foreign exchange savings.

Satellite uplink at Bangalore

The Seventh Plan of Doordarshan includes provision of a satellite uplink at Bangalore to relay its programmes by all transmitters in Karnataka

Giving this information in the Lok Sabha, Mr V N Gadgil, minister of state for Information and Broadcasting, said that this mode of linkage would depend on the availability of additional satellite capability

Electronic telex facilities to be expanded

The Department of Telecommunications has prepared a plan to provide more electronic telex exchanges in the major cities of the country during the Seventh five-year Plan period

The existing capacity of the electronic telex exchanges at Bombay and New Delhi will be expanded by 7000 and 4000 lines respectively Calcutta and Madras telex exchanges would also be expanded by another 2500 and 1200 lines respectively

The present electromechanical telex exchanges at Ahmedabad, Bangalore, Hyderabad and Ernakulam would be expanded with electronic telex equipment by 2000, 2700, 2000 and 1750 lines respectively Similarly, the telex exchanges at Jaipur, Guwahati, Baroda and Chandigarh will also be expanded by 1050, 500, 700 and 700 lines respectively, while Lucknow and Pune telex exchanges will get another 500 and 1000 lines

Electronic telex exchanges have been provided at Bombay, Delhi, Calcutta and Madras. These exchanges are planned to be expanded as and when the need arises. Similar electronic telex exchanges are proposed to be provided at Ahmedabad, Bangalore, Hyderabad, Ernakulam, Jaipur, Guwahati, Baroda, Chandigarh, Lucknow and Pune.

Digital exchanges to be commissioned

Fifty-one digital exchanges are proposed to be commissioned during the year 1986-87 by the Department of Telecommunications.

These exchanges are likely to be set up in the cities of Agra, Armoor, Ambikapur, Alipurdwar, Bombay, Bajpe, Betul, Balaghat, Bilaspur, Baripada, Calcutta, Chhaturpur, Delhi, Datia, Dhar, Dhenkanal, Dungarpur, Dhatav, Guna, Gazipur, Hamirpur, Kothagudem, Kodinar, Kalpatta, Kulu, Keonjhar, Lucknow, Madhubani, Mannar, Manmed, Naharlagon, Pune, Purnea, Ramachanderapuram, Shajapur, Shivpuri, Sultanpur, Sainthia, S L. Puram, Trichy, Una and Yelwal.

Apart from these cities, Ahmedabad, Amritsar, Bangalore, Bhopal and Baroda are among the 74 other cities which are expected to enter the digital era by the end of the Seventh five-year Plan period.

TV transmitters for UP

The establishment of one high-power (10kW), eight low power (100W) and seven very low power (2×10W) TV transmitters in Uttar Pradesh has been included in the Seventh Plan of Doordarshan

The implementation of these schemes would depend on the actual year-wise allocation of resources. Under these schemes, TV service is expected to be available to about 91 per cent of the rural population of the state. Further expansion of TV service will be carried out in phases, depending on the availability of resources for this purpose during future plans.

All the 56 districts in the state are expected to be covered by TV service, either wholly or partially by these schemes.

Knowhow offered by ISRO

The Space Applications Centre of ISRO offers technical knowhow and consultancy services to interested electronics companies for the production of various satellite communication equipment.

The technical knowhow is offered for TVRO terminals, low-cost satellite communication terminals, low-noise amplifiers, antennae (3m, 4.5m, 6.1m and 14m) and amplifiers (100W, 400W and 3kW). Consultancy is offered for systems engineering.

Electronics industries in the public/joint/private sector with experience in related fields may write for details to the deputy manager, Technology Transfer, Space Applications Centre, Jodhpur Tekra, Ahmedabad 380053.

ISRO also offers knowhow to interested entrepreneurs for manufacturing industrial and consumer products like the crane control system for tilting objects automatically, worm driven mechanical screw jacks and domestic electrical shock protectors Further details can be obtained about these products from Mr K. Viswanathan, the Coordinator, Technology Transfer, SPROB, SHAR Centre, Sriharikota, Distt Nellore 524124, Tamil Nadu.

TV coverage in Kerala

TV in Kerala at present covers about 77.5 per cent population of the state.

The establishment of four new low-power (100W) TV transmitters in Kerala has been included in the Seventh Plan of Doordarshan. On implementation of these schemes, TV coverage in the state is expected to increase to about 85.7 per cent of its population.

EPABX project in Haryana

Haryana has set up an important project to manufacture electronic PABX with indigenous technology developed by the Centre for Development of Telematics (CDOT), set up by the government as an R&D organisation to provide self-reliance in the field of telecommunications

The technology developed by CDOT compares favourably with the technology available anywhere else in the world but specifically designed for Indian conditions, such as high traffic and large temperature variations, etc. The exchange has a maximum capacity of 128 lines

The project is being set up by Hartron in the assisted sector with Naina Electronics Pvt Ltd, Chandigarh—a leading electronic instruments manufacturer. The project, with an estimated investment and turnover of Rs 20 million and Rs 60 million respectively, is expected to start production next year. It will be the first project in north India to manufacture electronic PABX.

The Department of Electronics, has estimated an annual demand of 250,000 lines by 1989-90 which is to grow even further with the availability of high quality, reliable equipment. The project is proposed to be set up at Panchkuia with an initial annual capacity of 20,000 lines.

Elcina decries 'kit culture'

A strong indigenous electronic component base for the healthy growth of Indian electronic component industry was the central theme of the conference held in Madras between newsmen and the executive committee of the Electronic Component Industries Association (Elcina).

The centre's policy of encouraging the import of CKD and SKD kits for colour TVs, computers and now telecommunication industry at the cost of the domestic component industry came in for a good deal of criticism. The high import duty on raw materials, combined with the absurdly low duty on imported components as compared to the levies on locally available components has paralysed the domestic manufacture of components and drained valuable foreign exchange resource.

Elcina urged the government to formulate policies aimed at the healthy and balanced growth of the electronic component industry and provide a total package of incentives for integrated development including interest-subsidy low cost raw material, inputs and direct tax incentives.

Videsh Sanchar Nigam formed

The Videsh Sanchar Nigam Limited (VSNL), successor to Overseas Communication Service, was formed on April 1, 1986 to provide improved telecom services to the nation.

VSNL, a government of India enterprise, will bring the state-of-the-art technology in the form of computerised exchanges, telecom satellites, submarine telephones, etc. The various international telecom services provided by VSNL include semi-automatic and manual telephone service to all countries, selective international subscriber dialling to 11 countries, direct subscriber telex dial service to all countries, international TV service, private leased channels programme transmission, digital facsimile radio photo services (Bureaufax), international telephone conference service (Incotel) and leased data circuits.

Fibre optic data links for Bombay offshore project

A fibre optic communications system will be used for the Bombay offshore project. The components have been imported by the Indian Telephone Industries Ltd from Math Associates, USA. The components will be used in an 88-channel, 5000m link to interconnect computer systems and satellite links. The installation will be used to speed the flow of data needed in the daily operation and management of the oil and gas production and distribution system. The communications system will be used in Project Titan, conducted by the Oil & Natural Gas Commission (ONGC).

Fibre optic data links are ideal for this application because of their ease of installation, resistance to electromagnetic interference and short circuits that could be created with traditional copper cables. These factors are of prime importance in this application since the fibre optic cable is buried directly in the ground for most of its path.

The very high data rates that fibre optics offers, along with the interference-free feature, make this technology a natural alternative to coaxial cable in a wide variety of similar data transmission applications.

Japanese collaboration agreements

Up to end 1985, 112 Indian collaborations had been approved with Japan in areas including electronic components for TVs, radios etc, analogue watches, data acquisition systems, floppy disc drives, single multiplex telecom systems, phono-cardiographs, micromotors, two-way communication and allied equipment, plain paper photo copiers, etc.

Of the 112 technical collaborations approved, 29 are with public sector undertakings and remaining with private sector companies.

In the area of colour picture tubes, foreign collaboration agreement has already been signed between UPLC and Toshiba, while PDDL proposes to sign an agreement with Hitachi soon.

The collaboration agreement for the manufacture of VCR decks between BPL, Bangalore and Sanyo, Japan has been signed. In the area of CTV components, Electronic Research Pvt Ltd and Sanyo have agreed to join hands.

Import of technology is allowed only on a case to case basis after examining all aspects including its impact on the indigenous production.

National Microelectronics Council

The government has set up the National Microelectronics Council (NMC) to act as an apex body and monitor the direction, pace and quality of the overall programmes in the field of microelectronics, keeping in view the larger national interests.

The council will periodically review and update the integrated national plans for microelectronics covering R&D, technology development, production, applications etc in all areas. It will also formulate all fiscal, import, industrial licensing and other regulatory and promotional policies which may be necessary to ensure a strong technological and production capacity in the country.

Prominent people connected with electronics are members of the council, which includes two specialists in the area of microelectronics.

Training programme for TV technicians

The government has started a crash programme for training service technicians for common consumer electronics products like TVs and VCRs This will be in addition to the existing skilled manpower already available.

Forty-four industrial training institutes have been identified to initiate this programme from June this year, at widely dispersed locations. Since skilled persons, on reasonable charges, are not easily available in rural areas, this programme will ensure that services of these technicians become available in all parts of the country. The government proposes to extend this programme to about 100 ITIs and polytechnics.

....AND ABROAD

Indo-Soviet seminar on solidstate chemistry

An Indo-Soviet joint seminar on the problems of solidstate chemistry will be held in September at Novosibirsk, USSR. Prof. C.N.R. Rao, president, Indian National Science Academy will head the Indian delegation to the seminar. The seminar aims at furthering Indo-USSR cooperation in the field of science.

According to Prof. Koptyug, vice-president, USSR Academy of Sciences, solidstate chemistry is an important field in which both the countries could cooperate for mutual benefit. Joint research is going on, especially in the field of microelectronics and organic chemistry, and scientists at the Centre of Synchrotronous Radiation at the Bhaba Atomic Research Centre are studying the new accelerator developed by the Institute of Nuclear Physics, Novosibirsk, with a view to developing new technology in this field.

In the field of catalysis, Soviet scientists are carrying on joint research with the scientists of the National Chemical Laboratory, Pune. The USSR is keen to step up its cooperation with India in biotechnology. Joint projects in this field are proposed in the near future. Scientific cooperation between the two countries under the 1985 agreement has opened up new fields and directions of joint endeavour for the next five years.

Programmed crystals

Physicists at the Kharkov Polytechnical Institute in the USSR have developed synthetic crystals which are used in microelectronics, optics and in computer, laser and cryogenic technology.

Whatever their diversity, naturally-occurring crystals have a somewhat limited range of lattice patterns, about 200. It is only an infinitesimal part of all the possible versions. These scientists undertook the designing of crystals not found in nature. Figuratively speaking, in this research separate atoms are arranged in a crystal lattice according to the preset programme.

'Programmed' crystals can be created, with various additions, to have different properties. Neutron microscopes with such crystals will allow an insight into the unknown depths of substance, for example into atomic nuclei, to study the intrinsic processes. Artificial crystals will help improve lasers and increase computer speed.

Seminar on Swiss Telecom

A seminar on telecommunications from Switzerland was recently organised by the Swiss Embassy in cooperation with the Department of Telecommunications.

The two-day seminar held on April 14-15, focussed on the telecommunications industry of Switzerland and explored the possibilities of opening up a partnership with India. The Swiss telecom industry is remarkably diversified, considering the size of the country. It produces telephone exchanges, transmission systems peripherals, radio and TV equipment, information systems, cables and wires, measuring instruments and electronic equipment and components—knowhow for all of which it is willing to share with India.

MESAR—the 21st century radar

The radar of the 21st century will not only be many times more effective than today's, but will be simpler and more economic. The equipment of the future will be known as MESAR (multifunction electronic scanned adaptive radar) and will be based on a technology in which the Plessey group is a world leader.

MESAR is being developed jointly by Plessey's Allen Clark Research Centre and Britain's Admiralty Research Establishment. Trials on-board ships could be mounted by 1990. Versions are also planned for on-land stations and vehicles, as well as for early warning aircraft.

The equipment is multifunctional in combining the tasks of surveillance (searching for hostile air traffic) and tracking (keeping watch on such traffic when found), which are currently carried out by separate shipboard radars. By halving the number of radars needed, it will bring large-scale economies.

Since it scans electronically, MESAR can deal simultaneously with multiple threats - aircraft, helicopters or missiles. Conventional scanning dishes take several seconds to switch between targets, which is unacceptable if they include supersonic, low-level aircraft covering a third of a kilometre every second.

MESAR adapts its scan to avoid jamming from any number of sources. It is also adaptive in that its scan dwells for longer on fast-moving objects, which are likely to be a danger, than on slower masses such as chaff—the clouds of metallised matter ejected by aircraft to distract attention from themselves.

Korea Electronics Show '86

The 17th annual Korea Electronics Show (KES '86) will be held from October 8 to 13 at the Korea Exhibition Centre (KOEX) in Seoul. The show has been organised by the Electronic Industries Association of Korea (EIAK) and sponsored by the Korean Ministry of Trade & Industry.

KES has been an international event since 1969, exhibiting the entire range of state-of-the-art electronics products covering the industrial and the commercial equipment and components. Both Korean as well as international companies are expected to take part. Seminars and talks will also be held during the show. Further details can be obtained from Electronic Industries Association of Korea (EIAK), Electronics Building, 12th Floor, 648 Yeogsam—Dong, Gangnam-Ku, Seoul, Korea.

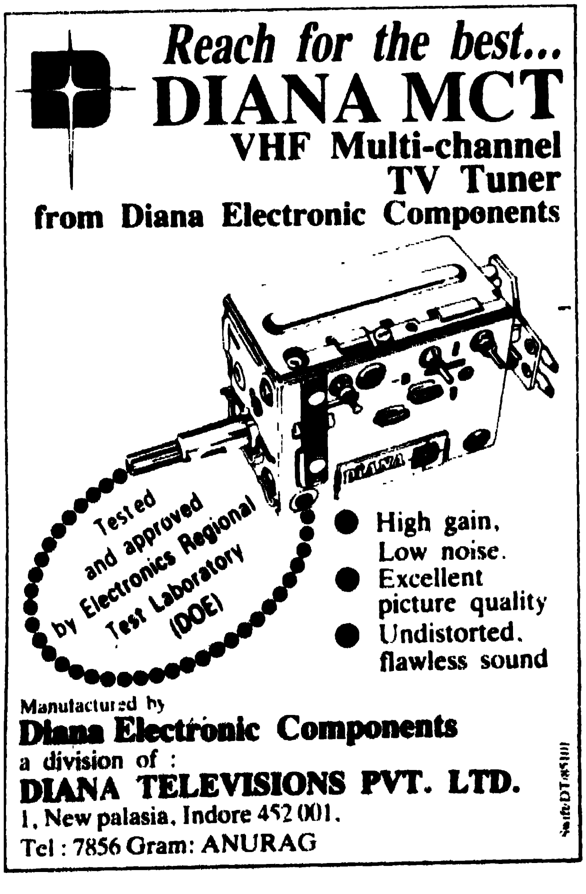
The tools of industry for British students

Every electronics student in Britain's 45 universities will soon have access to the industry's own widely used computer programs. The new ability to teach students how to design integrated circuits by using software identical to those used by their potential employers in the industry is made possible by an agreement between Britain's University Grants Committee (UGC) and five major electronics firms.

The agreement, which could put Britain among the leaders in the teaching of computer design, involves a major discount on computer programs and equipment that would normally retail for a total of £25 million. Each of the 45 universities will get equipment valued at £500,000. First deliveries are expected soon and most universities should be using common computer programs on new courses by next year. Among the five suppliers are the British companies Racal-Redac, Qudos and Silicon Microsystems.

Every electronics student in UK universities will now learn how to design integrated circuits using the same software system. In the industry it is estimated that within five to ten years every design engineer will have to design using electronic systems. So this agreement will help the UK to stay at the forefront in the design of big systems.

Universities may face initial problems of using standardised programs on a variety of different computers now in use. However, the UGC will provide funds if extra machines have to be bought for compatibility.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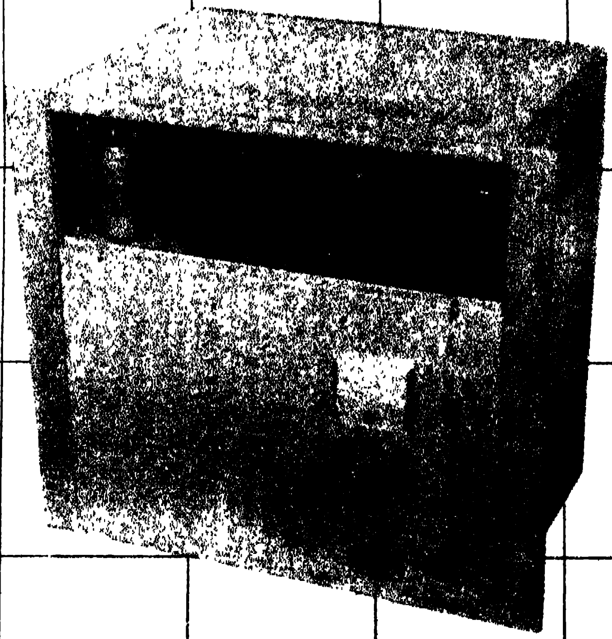

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Cable Television

R.R. Warrier

As the name implies, cable TV uses cables for television programme distribution. It is natural to ask why a costly medium like the cable should be used when programmes can be broadcast by electromagnetic radiation at a lower cost and to a far wider audience. The fact that cable TV thrives even in areas served by broadcast stations indicates that 'cablecasting' possesses some desirable features not obtained in broadcasting. Let us see what those are.

Radiated electromagnetic spectrum is a 'common resource' utilised by all types of wireless activities. Consequently, there is a need to regulate its usage to ensure interference-free communication. By international consensus, a certain amount of space in this spectrum has been allocatted for TV broadcasting (Fig. 1). Of the allocatted channels, only a few can be used for transmission at any locality to avoid interference. This, apart from financial constraints, severely limits the number of channels 'on air' in any locality. Thus, a limited number of broadcasting stations have to cater for the widely differing tastes of a large audience.

Cable TV on the other hand, caters for the needs of a small community. Even to the small homogeneous communities it serves, cable TV can offer a wide choice of programme material. As the coaxial cable hardly radiates, there is no need to strictly regulate the number of channels it carries. Often, a cable TV system carries a large number of channels so that there is a wider range of viewing alternatives than is possible with over-the-air reception. Again, as cable TV makes hardly any demands on the radiated electromagnetic spectrum, a large number of cable TV systems and broadcasting channels can co-exist in any given locality. In addition, cable TV can provide consistently strong, interference-free signals because the signals carried by a coaxial cable are not significantly affected by external interference and noise. Contrast this with over-the-air reception plagued by noise and interference, shadow zones created by tall obstructions, ghosting due to reflections, and so on.

A cable network has the potential to offer other types of services such as interactive TV or subscriber participation by upstream communication from the subscriber to the originator. FM radio distribution, data and video text retrieval etc, are other applications the cable TV system can be put to.

Cable TV, CATV and MATV

Cable TV originated in the US around 1950 as a result of the vigorous efforts made to extend TV coverage to areas not covered by broadcasting stations. Communities living in the fringe areas of TV stations found that they could obtain satisfactory TV coverage by erecting a good antenna system atop tall buildings or mountains and distributing the received signals within the community by means of cables.

Mr R.R. Warrier is with the Vikram Sarabhai Space Centre, Trivandrum.

of even the elaborate CATV antenna, programmes were brought in from distant stations by microwave links, and later by satellite links, to feed the cable network.

With the advent of the video tape recorder and cheaper studio equipment, the dependence on broadcast programmes lessened and local origination of programmes

become a misnomer for cable TV systems in general. However, the term stuck, though nowadays the CATV function is actually performed by master antenna television (MATV) systems. The master antenna replaces the individual receiving antennae of localised areas such as an apartment building, avoiding the clustering of antennae as well as the

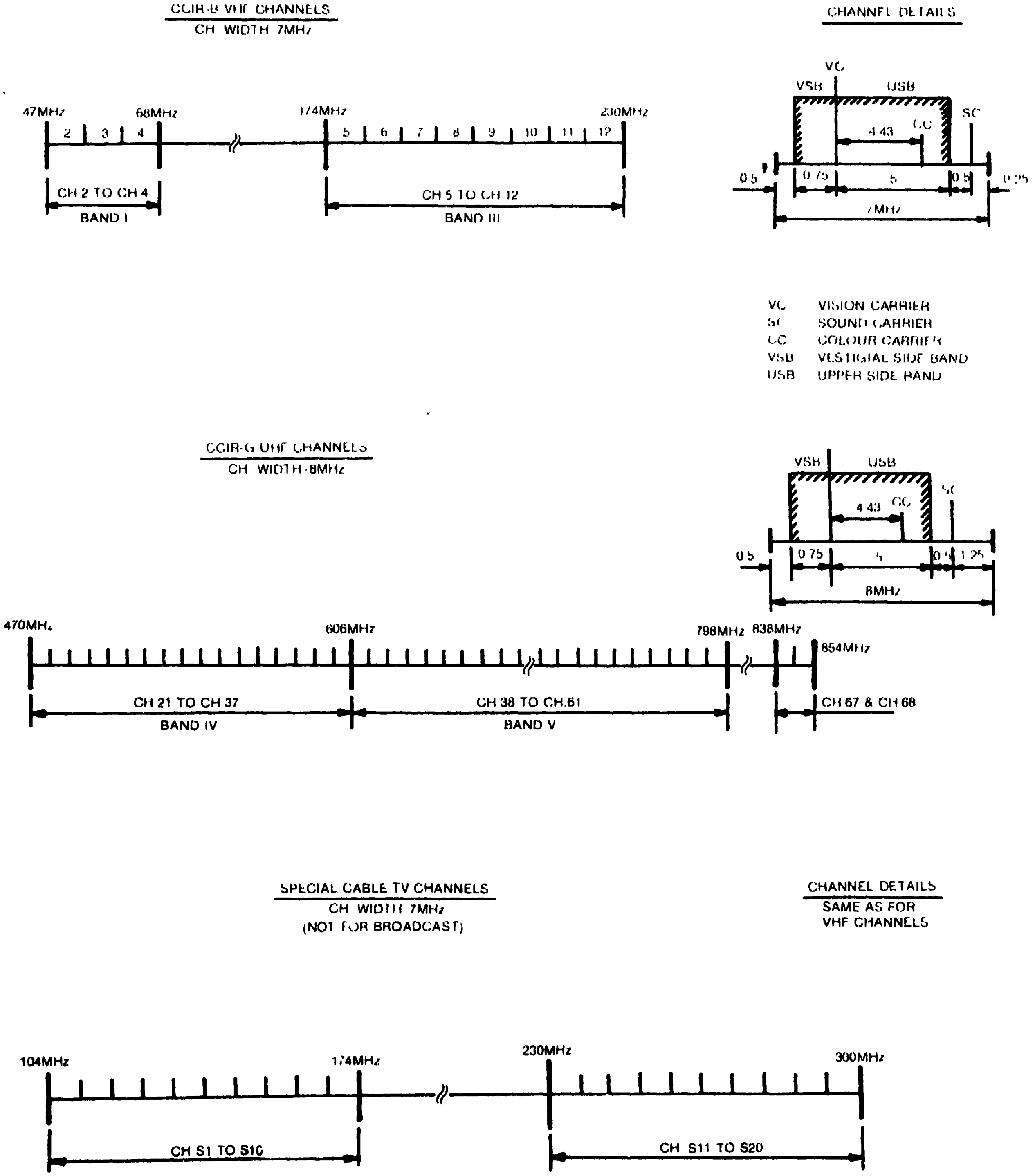

Fig. 1: CCIR channel allocation for TV broadcasting.

offer better reception than is economically possible with individual antennae.

Cable TV system

A lot of variation can be found in the configuration of cable TV systems. At one end are those that hardly deserve hook-up of a couple of VCRs, a local reception antenna and a few receivers. At the other end are the highly complex interactive cable systems. Fig. 2 shows a simplified diagram of a typical cable TV installation falling between these two extremes.

In the diagram, the programmes are shown to originate at

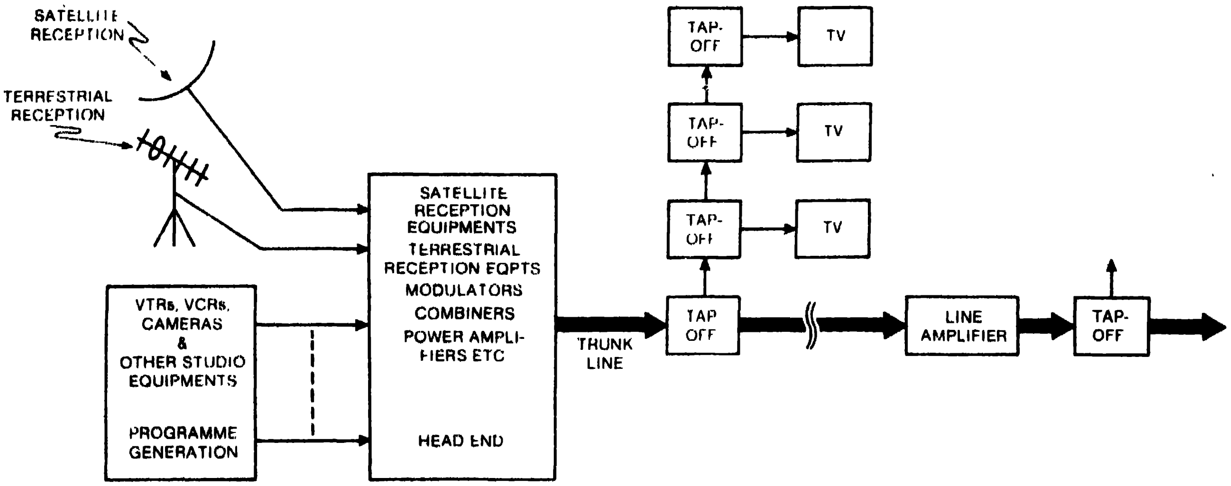

Fig. 2: A typical cable TV system.

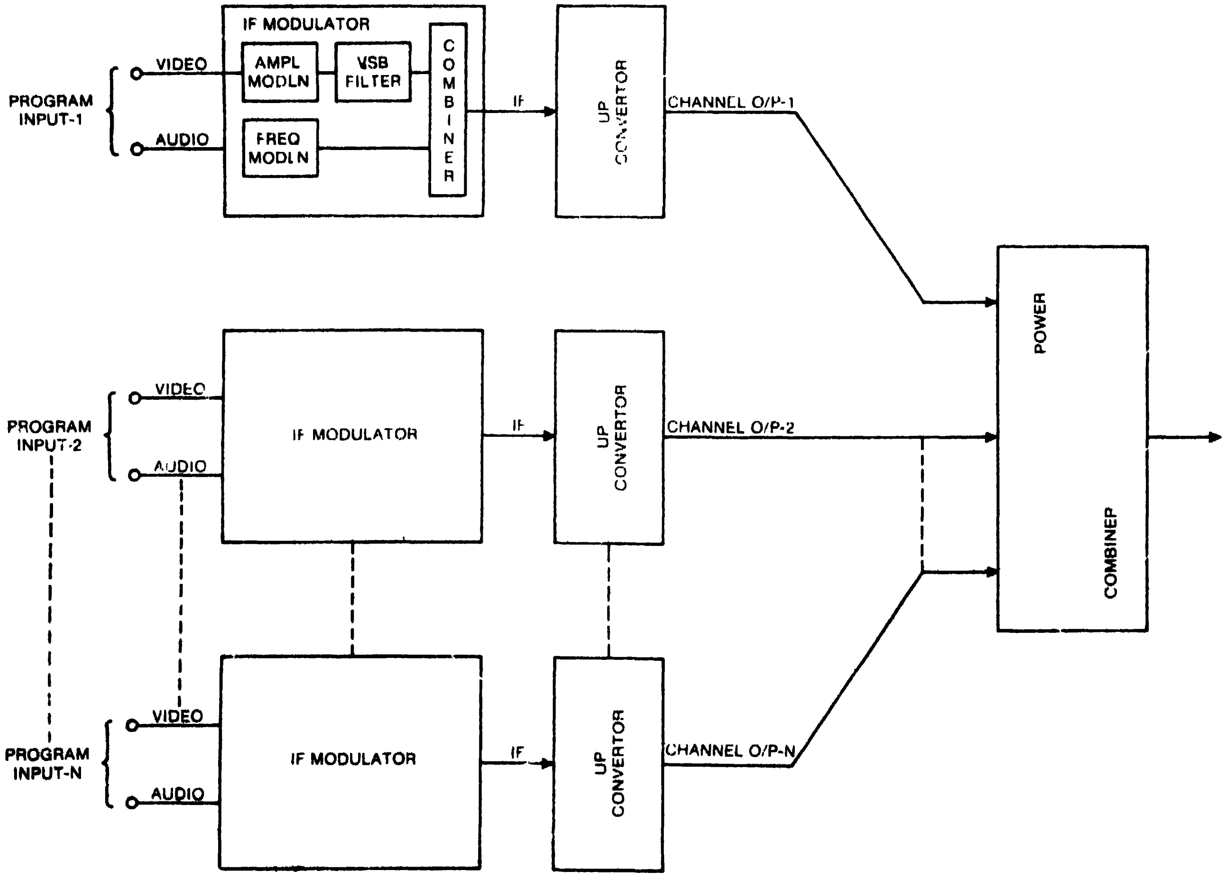

Fig. 3: Multiplexing at the head-end.

the programme generation centre whose complexity can range from that of a full-fledged TV studio to just a VCR. In addition to the locally generated programmes, over-the-air programmes such as those received from nearby stations, or brought from distant stations by microwave link or those relayed by satellites, are also fed into the cable network. While local reception is possible at the originating end of the cable TV with equipment similar to that used in conventional TV reception, microwave and satellite reception imply a more sophisticated hardware. Satellite reception is possible only with a TVRO (TV receive only) terminal or direct reception systems.

Head-end and multiplexing

The equipment which actually feeds the programmes into the cable is located at the head-end. The head-end of the cable TV system is not to be confused with the head-end or front-end of receiving equipment such as a TVRO. One function performed at the cable TV head-end is the multiplexing of the different programme inputs. This is necessary since a number of programmes have to be transmitted simultaneously on a single cable. Multiplexing is done by modulating the programme signals on suitable carriers.

Modulation and carrier frequencies compatible with those of broadcasting transmission are used so that ordinary TV sets can be used for reception. In other words, VSB-AM (vestigial side band amplitude modulation) for vision and FM for sound are employed, while conventional VHF channels (sometimes extended VHF and rarely UHF channels) are used for transmission.

Fig. 3 shows how this is achieved. The IF modulators, identical for all channels, modulate the video and audio signals of the programme on an intermediate frequency (generally 38.9 MHz for vision and 33.4 MHz for sound in CCIR-B systems).

The up-converter of each channel converts the IF to the desired channel frequencies. Although direct modulation on channel frequencies is possible, the IF modulator concept is generally favoured because the sophisticated modulating hardware would then be identical for all channels.

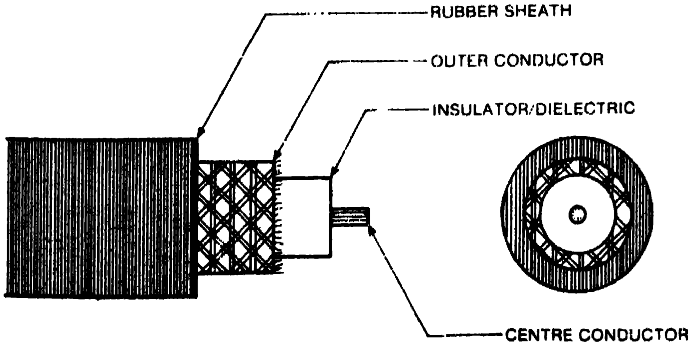

Fig. 4: The coaxial cable.

The cable network

The different channel outputs from the up-converters are combined in a power combiner, and fed to the trunk line after suitable amplification. From this trunk line, feeder lines branch off to different subscriber clusters. Signals are provided to the subscribers' sets by means of drop lines.

In cable TV, the transmission medium is the coaxial cable, shown in Fig. 4. The cable used should have the capability to handle the combined bandwidth of all the desired channels. The higher the frequency of operation, the higher the cable attenuation (Fig. 5). This was why UHF channels were not initially very common in cable TV systems. Another requirement is that the radiation emanating from the cables should be negligible in order to avoid interference. Cables can be mounted on poles, laid underground or within buildings, and routed through convenient channels.

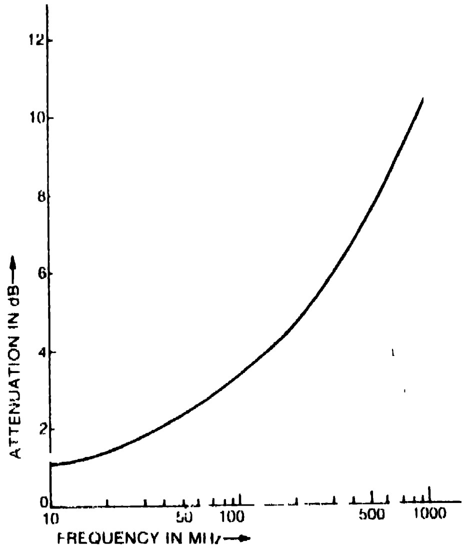

Fig. 5: The frequency characteristics of a typical CATV cable of unit length.

Amplifiers

Amplifiers are required at the head-end as well as at the repeaters at suitable intervals in the cable route. The number of repeater amplifiers and the power required from the head-end amplifier can be reduced if low-loss cables are used. But the lower the loss of the cable, the higher is its cost. A compromise can be made if the amplifiers used are wideband, have good linearity and offer low noise.

As seen from Fig. 1, if all the VHF channels are to be used, the amplifier should operate from 47 MHz to 230 MHz. In some countries, cable TV utilises extended VHF range up to 300 MHz, including special cable TV channels. The amplifier should have flat bandwidth in the operating frequency range or, more preferably, should have a slope to compensate for the cable response.

The amplitude modulated TV signals cannot tolerate nonlinearity in the amplifiers as it results in heavy distortion. In

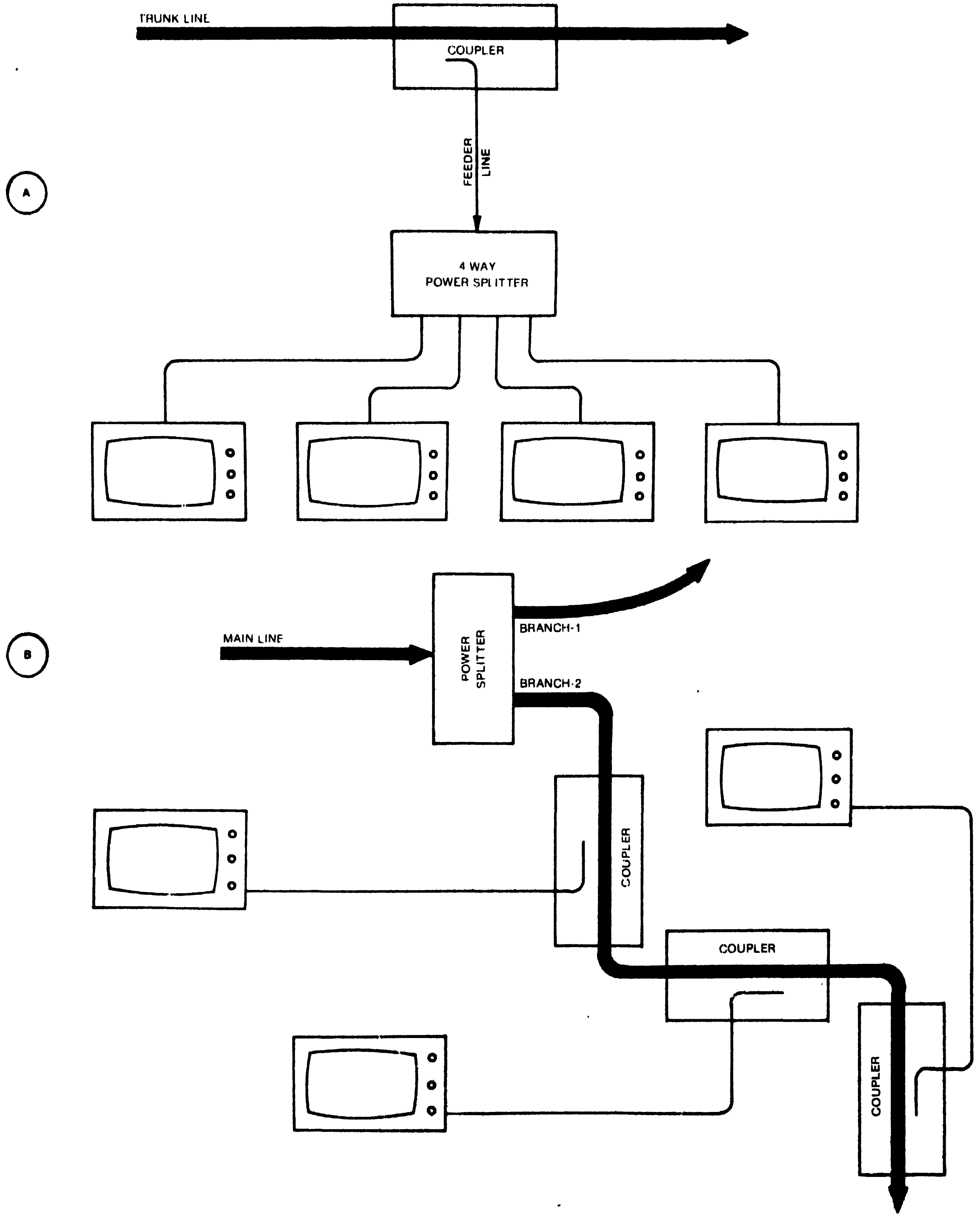

Fig. 6: Power splitters and couplers in a typical cable network.

addition, non-linearity is highly objectionable for multichannel operation because the intermodulation products, i.e., the products resulting from the non-linear mixing of the different channel frequencies and their harmonics, may then fall within the channels creating interference and additional distortion. Linearity is generally specified in terms of intermodulation products. For cable TV applications, the amplifiers generally have intermodulation products better than 50 dB down with respect to the carrier level.

In a long cable route, several amplifiers may be required to provide sufficient signal strength to the subscribers' sets. The noise contribution of each amplifier should be sufficiently low so as not to degrade the signal-to-noise ratio significantly.

The amplifiers used in cable TV systems are mostly solid-state. For medium power level, thin film modular amplifiers using hybrid (part integrated, and part discrete) techniques are very suitable. These can be considered as 'gain blocks' in that they can directly give the specified gain and impedance match (generally 75 ohms) without additional components. For more power, discrete transistor stages are employed.

Power splitters and couplers

Wherever signals are required to be tapped in a cable network, such as from the trunk to the feeder line or from the feeder line to the drop line, power splitters and couplers are used. Direct tapping which alters impedance levels creating mismatch attenuation, reflections and related signal and device degradation, can be avoided by using power splitters. In addition, they provide a certain amount of isolation between the tapped and the tapping lines. The power splitters and couplers are passive elements and hence the sum of the power levels at all the output ports is equal to the input power, except for an insignificant insertion loss. Splitters are configured as two-way, three-way and so on, while couplers have couplings of the order of 3 dB, 5 dB, 10 dB, 20 dB, and so on. Couplers are sometimes referred to as 'tap-offs'. Fig. 6 shows the different ways in which these can be employed.

Power splitters and tap-offs are fabricated using transmission line techniques or wirewound ferrite core transformers. Microstrips, thin films, and hybrid techniques achieve a fair degree of miniaturisation. The wide bandwidths required for cable TV are also achieved by these techniques.

The subscriber's set

An advantage of cable TV is that an ordinary TV set can be used by the subscriber. The cable is connected at the antenna terminals of the set. The Indian black-and-white TV sets have 300-ohm impedance at the antenna terminals. To match the 75-ohm cable, either the built-in balun transformer can be removed or an additional transformer can be introduced. If the special cable TV channels are also used (Fig. 1), then the TV set would have to be tunable in this range.

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A perspective

It was mentioned earlier that cablecasting can extend TV coverage, offer more viewing alternatives than broadcasting and provide better signals than are possible with over-the-air reception—all this without making any demands on radiated spectrum space. Possibilities have been projected of a wired nation, a network of cables covering the entire nation connecting futuristic interactive home terminals which will make possible all kinds of dealings to be done at home—from shopping to face to face conferences to accessing computers. It is certain that cable TV will play a significant role in the fields of entertainment and interactive information retrieval in the homes of the future.

All this at what cost? It is pointed out that the reception of broadcast TV is free while one pays for cable TV reception. Fears have been expressed that cable TV may siphon off good programmes which may otherwise have gone on the broadcasting channels. Ultimately, it is remarked, cable TV may create two classes of viewers—those who can afford only the free broadcast programmes and those who can pay for the cablecast programmes which may turn out to be superior.

Though there may be an element of truth in these arguments, it is felt that both cable and over-the-air TV can co-exist harmoniously, each being a complement to the other, each performing its role in improving the quality and extending the utility of the medium of television. □

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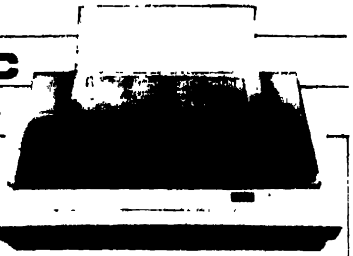

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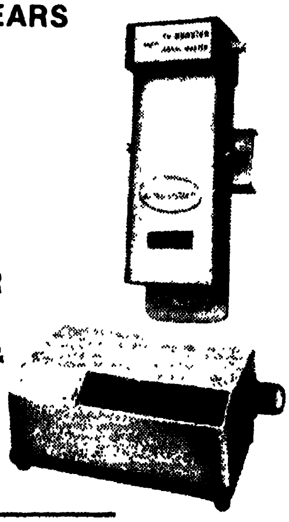

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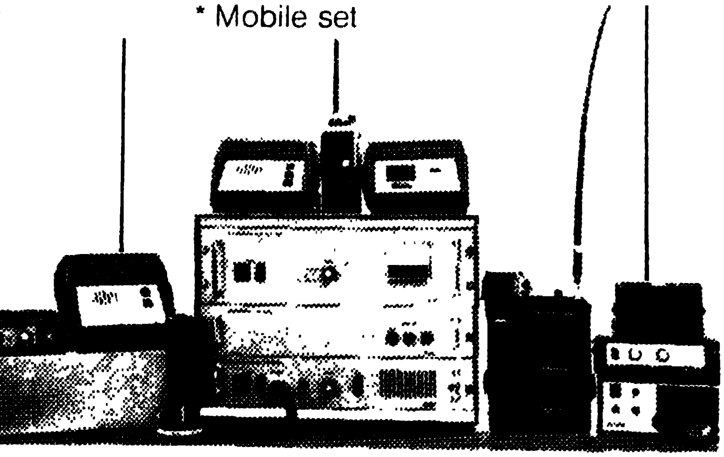

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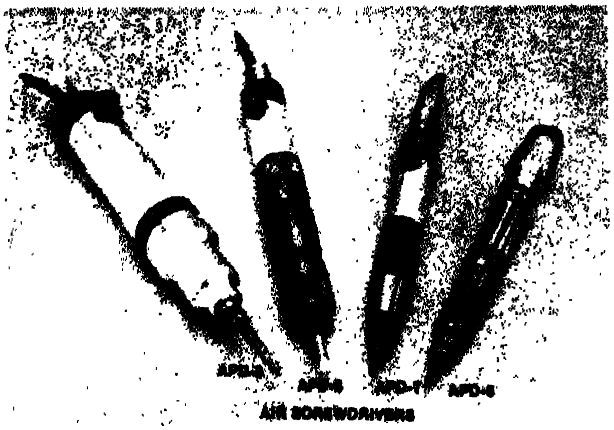

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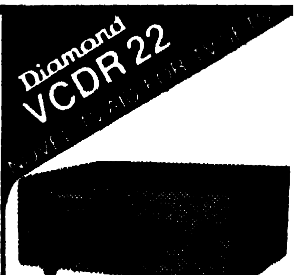

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A Profile of Electronics Production During 1985

Both electronic equipment and components industry have registered a substantial growth during 1985. The total production of electronics in 1985 is estimated to be about Rs 26,600 million compared to Rs 18,900 million in 1984 and Rs 13,600 million in 1983. Thus, the growth rate achieved during 1985 was 40.7 per cent compared to 39 per cent achieved during the previous year.

The highlighting feature of the growth in 1985 is the fact that there has been a substantial fall in prices of items like computers, some of the components and consumer electronic products. Thus, in physical terms, the growth in 1985 is likely to be more than 40 per cent.

Sectorwise production of electronics during the last three years is given below:

Sectorwise Production of Electronic Equipment and Components

(Rs in Million)

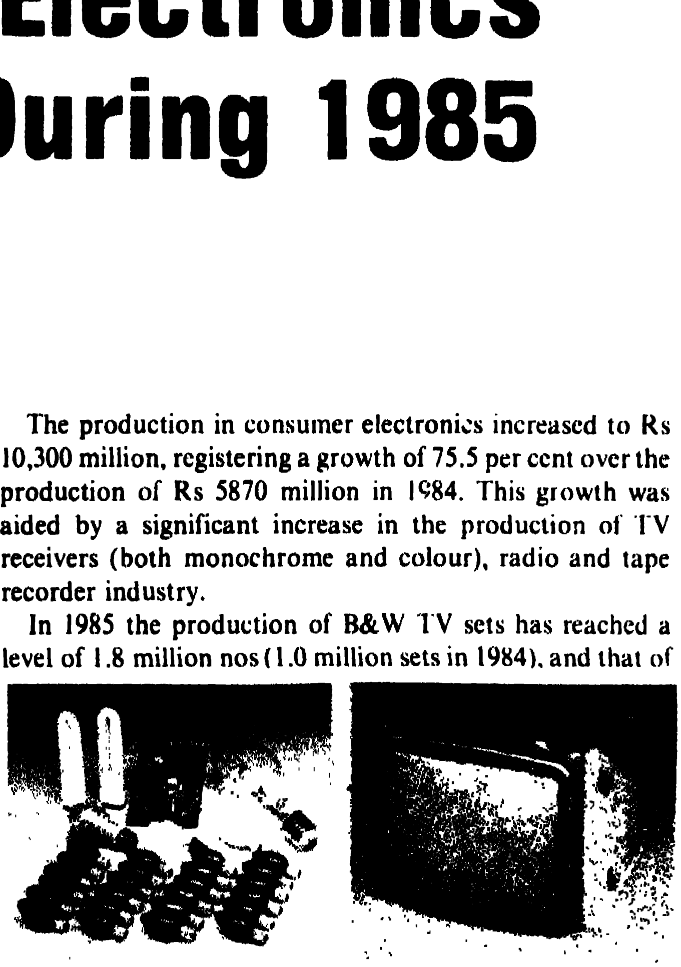
Sl. No.	Sector	Calendar Year Production		
		1983	1984	1985
1.	Consumer Electronics	3300	5870	10300
2.	Communication & Broadcasting	2700	3205	3800
3.	Aerospace & Defence	1260	1490	1960
4.	Control Instrumentation & Industrial Electronics*	2510	3350	4040
5.	Computer Systems	780	920	1550
6.	Components	2300	3030	4100
7.	SEEPZ	750	1035	850
	TOTAL	13600	18900	26600

*including Medical Electronics Equipment, Test & Measuring Equipment and Office Automation Equipment.

Based on 1985-86 Annual Report of the Department of Electronics, the government of India.

The production in consumer electronics increased to Rs 10,300 million, registering a growth of 75.5 per cent over the production of Rs 5870 million in 1984. This growth was aided by a significant increase in the production of TV receivers (both monochrome and colour), radio and tape recorder industry.

In 1985 the production of B&W TV sets has reached a level of 1.8 million nos (1.0 million sets in 1984), and that of CTV receivers to a level of 0.66 million sets (0.28 million sets in 1984). The production of tape recorders has increased from 1.22 million nos in 1984 to about 2 million nos in 1985.



The communication and broadcasting sector has shown a growth rate of 18 per cent, with production increasing from 3205 million in 1984 to Rs 3800 million in 1985. The new projects which were initiated during the last few years have started contributing to production. However, most of the growth in this sector during 1985 is due to the existing products only. Better growth is expected in the next 12 to 18 months.

The aerospace and defence sector has registered an increase of 31.5 per cent, with a production level of Rs 1960 million in 1985 compared to Rs 1490 million in 1984.

In the area of process control and industrial electronics, the growth rate achieved was 20.6 per cent. The growth in this sector generally depends on the modernisation programmes of the user industries which in turn depend on the budgetary allocations made by the government to different ministries.

In the area of computer systems, the indigenous production has increased from Rs 920 million in 1984 to Rs 1550 million in 1985, thus registering a growth rate of 68.5 per cent in monetary terms.

It may be noted that, after the announcement of new computer policy, there has been a substantial reduction in the prices of indigenously manufactured computers. Compared to a production of 2000 mini/micro systems during 1984, the production during 1985 for these items is expected to be around 5000 to 5500 systems. The industry has thus shown a 150 per cent growth during the year in physical terms.

A significant growth in the production of consumer electronics has provided impetus to the component sector and the industry has registered a growth of 35.3 per cent. Production of B&W TV picture tubes increased from 0.81 million in 1984 to 1.45 million nos in 1985, thus registering a growth of about 80 per cent. However, growth in the semiconductor sector is much smaller than the overall growth in demand.

The production of passive components has increased in step with the demand from indigenous industry. Further rationalisation in the duty on input material is still awaited by this industry.

The growth rate and percentage share of different sectors during 1985 is summarised below:

Sector	Growth Rate (Percentage 1985)	Share of Different Sectors in Production 1985
1. Consumer Electronics	75.5	38.7
2. Communication and Broadcasting	18.0	14.3
3. Aerospace and Defence	31.5	7.4
4. Control Instrumentation & Industrial Electronics	20.6	15.2
5. Computer Systems	68.5	5.8
6. Electronic Components	35.3	15.4
7. Santacruz Export Processing Zone,(SEEPZ)	( )17.9	3.2
8 Over-all	40.7	

PRODUCT-WISE GROWTH

Components

The production of the electronic components during the calendar year 1985 was Rs 4100 million in comparison to Rs 3030 million in 1984, representing a growth rate of 35.3 per cent. A very significant growth was recorded in the area of B&W picture tubes, integrated circuits (both MOS and bipolar), professional-grade PCBs and audio magnetic tapes.

The highlight of 1985 was that major investments have been committed in the area of colour picture tubes. Substantial progress has also been made in the area of critical components for colour TV and it is expected that production of most of these items will commence during the second year of the Plan.

The components sector was delicensed in March 1985 with the intention of attracting large investments. Efforts are being made to reduce input costs for this industry so that components can be produced at near international prices.

To expedite clearance of project proposals by the financial institutions a working group has been set up with representatives of Departments of Electronics, Industrial Development and Industrial Development Bank of India.

Consumer electronics

Consumer electronics continues to show sustained progress. The growth in the second year in succession was 75.5 per cent in financial terms. This growth was accompanied by falling prices. The growth in physical terms was significantly large.

Thus, as will be seen from the table below, the growth in production of B&W TV sets is 80 per cent; and of colour TV sets, 136 per cent in 1985 over the previous year.

Product	1984	1985	Percentage increase
	(Production in Rs million)		
Radio Receivers	6.2	7.5	21
Tape Recorders	1.2	2.0	66
B&W TV sets	1.0	1.8	80
Colour TV sets	0.28	0.66	136
Total production of consumer electronic products	Rs 5870 million	Rs 10,300 million	

This growth has largely been the result of various measures taken by the government. Some of these are:

1. Liberal policy of issuing industrial approvals of viable capacities, including broadbanding.
2. Abolition of the annual licence fee on radio receivers, and also on TV receivers, with one-time levy of Rs 100 per set by way of excise duty on TVs in lieu thereof.
3. Abolition of Dealers' Possession Licence for the sale of radio and TV sets.
4. Improvement in software.

Companies with foreign equity not exceeding 40 per cent are also now eligible to be considered for TV receiver manufacture, subject to the condition that they will have to supply not less than 25 per cent of their production in kit form to small scale units for five years from the date such companies go into production of TV sets. The ban on the use of foreign brand names in the manufacture and sale of TV sets, both colour and B&W, will of course continue to apply.

Almost all componnets used in radio receivers, tape recorders and B&W TV sets are manufactured indigenously and the import content in these is negligible. However, in colour TV sets the import content is high, with about 80 per cent of the components used in them being imported. As a result of a number of industrial approvals given for the manufacture of colour TV components, it is expected that many components used in colour TV may be indigenously available in about a year's time.

In the areas of VCR/VCP and microwave oven, the government had, through a press note, invited composite applications stating that only such units would be promoted which were prepared to commit sizeable investments for suitable vertical integration, with an accelerated phased manufacturing programme and which have the requisite in-built capacity to keep pace with the changing technology. Over 100 applications have been received in response for these products. These are being scrutinised by an inter-departmental task force. Introduction of these products is expected to give a further fillip to the consumer electronics industry.

Communications

A policy to secure the cooperation of private enterprises, on a selective basis, to manufacture communication equipment in the joint sector, and also to permit the manufacture of some of the items such as terminal equipment etc -wholly in the private sector—was announced by the government in March 1984. The following letters of intent have been issued for the products listed for private sector:

Product	No of LOI approved for private sector
1. Electronic Telephones	40
2. Electronic PABX	12
3. Electronic Teleprinters	2
4. Digital Facsimile Equipment	8
5. Electronic Pay Phones	3

ITI, Gonda has started production of ESS equipment. The Centre for Development of Telematics (CDOT) set up for development of digital electronic switching systems indigenously has completed the development of 128-line EPABX, and this technology is under consideration for transfer to industry for manufacture. This development will form the building block for the development of the large electronic exchanges.

Three technologies for manufacture of EPABX equipment, namely, from GTE (Belgium), OKI (Japan) and Jeumont Schneider (France), have been selected. Letters of intent for the manufacture of EPABX equipment have been given to 18 parties in public/private sector with an annual licensed capacity of 900,000 lines. Foreign collaboration approval has been issued to 11 parties.

Most of the units are expected to commence production in 1986-87. Some parties have commenced production of EPABX/PABX using indigenously developed technology.

Technology selection activity for the manufacture of digital rural automatic exchange (RAX) equipment has been started. Offers have been received from ten foreign bidders. Selection of technology is expected to be completed during 1986-87. Letters of intent for the manufacture of RAX equipment have been issued to eight parties in the public sector.

Transmission equipment

For the PCM primary equipment, the Department of Telecommunications (DoT) has chosen the equipment as per the construction practice developed by ITI, Bangalore. The knowhow for the equipment has been transferred by ITI, Bangalore to a number of state sector units. It is expected that the equipment will go into production in 1986-87.

DoT had projected the requirement of digital transmission equipment, viz, UHF, microwave, coaxial systems, trans and higher order mux equipment in the Seventh Plan. After considering the indigenous availability of knowhow for various products, action for procuring technology has been initiated. Indian industries to manufacture the equipment have been identified in consultation with DoT.

An Inter-Agency Single Point Industry Interface and Action Committee was set up by the government under the chairmanship of joint secretary (Telecom), DoE. This committee has been charged with the responsibility of taking time-bound single point action on clearance of industrial licensing, capital goods, raw material etc for indigenous manufacture of INSAT and allied ground equipment. During the year 1985-86, the committee met regularly and cleared applications/issues brought before it within 15 days. New equipment such as LCTs/ECTs and DSCPC are expected to be in production in 1986-87.

Two-way radio communication industry continues to grow to meet the requirements of civilian and defence users. A few additional letters of intent have been given to state sector units. FC/CG/PMP approvals have also been accorded for the manufacture of this class of equipment to various holders of letters of intent. Additional units, namely, Elcot and Keonics, have come into production and a few units such as Uptron and Meltron are going to undertake production of additional items like duplex transreceivers and transreceivers for security forces etc.

To meet the requirement of defence users for two-way radio communication equipment some units in state sector, namely, PWSL, Elcot, Webel and HPSIDC have been promoted.

The Department of Telecommunications has projected a large requirement of multi-access rural radio telephone systems (MART) during the Seventh five-year Plan. GCEL has commenced production and ITI has finalised their production programme Uptron has been accorded foreign collaboration approval with Fujitsu, Japan. Orissa State Electronics Development Corporation Ltd has been given a letter of intent for manufacture of digital multi-access radio telephone system.

Terminals

Three technologies for the manufacture of electronic pushbutton telephones and related critical components from Siemens (FRG), FACE (Italy) and Ericsson (Sweden) have been selected. Letters of intent for the manufacture of electronic telephones have been given to 50 parties in public/private sector and small-scale sector with an annual licensed capacity of 10.2 million numbers. Some parties are expected to commence production during 1986-87.

Hindustan Teleprinters Ltd (HTL) has been given foreign collaboration approval to manufacture electronic teleprinters with knowhow from Sagem, France. Phased manufacturing programme and import of capital goods have been approved. HTL is to commence production in 1986-87. Two more parties in the private sector have been given letters of intent for manufacture of electronic teleprinters with a capacity of 5000 numbers each.

The manufacture of digital facsimile equipment is expected to grow with the provision of facilities for interconnection on public switched telephone network (PSTN). Letters of intent have been recommended to be issued to 12 parties in public/private sector. Some parties are expected to commence production during 1986-87. Foreign collaboration and phased manufacturing programme of ECIL for this product has been approved.

The manufacture of electronic payphones has been promoted with grant of letters of intent to three parties in private sector with a total licensed capacity of 65,000 numbers. Foreign collaboration approval has been given to one party.

The Department of Telecommunications has now permitted use of cordless telephones. Three state sector units have been given letters of intent to undertake manufacture of the product.

Broadcasting

Successful implementation of the special plan for expansion of TV network to cover 70 per cent of population and deployment of Rs 500 million worth of professional electronics hardware covering low-power and high-power TV transmitters, TV receive-only (TVRO) terminals and programme production equipments during 1983 and 1984 had beyond doubt proved the capability of indigenous electronic industry. Having set up the basic infrastructure and network for the mass communication media, the government had laid emphasis on consolidating and strengthening of the programme production facilities. The six major public sector companies involved in the manufacture of broadcast electronics hardware, viz, BEL, GCEL, ECIL, Meltron, Keltron and Webel, maintained their stronghold in the broadcast electronic sector, by not only producing Rs 400 million worth of electronic equipment and components during 1985 for this sector but by continuously updating the technology through indigenous R&D, e.g., development of solar photovoltaic system powered very low-power TV transmitter (VLPT), and TVRO for unattended remote control operation, improved version of LPT with higher reliability, etc.

As a result of close interaction between the Ministry of I&B, Doordarshan and AIR, Rs 7500 million worth of electronic hardware requirements for the Seventh five-year Plan of the Ministry of I&B have been consolidated and finalised. Broad product allocation has also been worked out in consultation with the major companies involved in the broadcasting electronics and, accordingly, advance letters of intent placed on these companies. As a result, it is estimated that more than 85 per cent of the Rs 7500 million worth electronic hardware requirement of the Seventh Plan in this sector would be met indigenously.

All India Radio has planned to introduce FM broadcasting all over the country through deployment of around 200 FM transmitters. BEL and GCEL have already been geared up to meet the AIR requirement of FM transmitters through indigenous production. For the Seventh Plan requirement of Ministry of I&B, OB/IEFP vans for video and audio field programme production have been taken up for manufacture by BEL, GCEL and Meltron, while the studio transmitter links (1.5 GHz) for AIR are being manufactured by Meltron.

With a high degree of self-reliance in broadcast electronics sector, our companies are now making major efforts for exports.

Aerospace and defence electronics

Major activities of the Department of Electronics in this sector include promotional efforts for technology development, consideration of import of the equipment, examination of foreign collaboration proposals and industrial licences, consideration of EFC/PIB proposals and promoting indigenous development/manufacturing programmes to meet the projected needs in the product areas covered in this sector. These activities are undertaken through an extensive interaction/consultation with the various user organisations and industrial and development agencies.

As part of this activity exercises were carried out through various committees to identify long-term requirements of the defence and civilian users such as civil aviation, meteorology, shipping, home affairs for various electronics equipment. Reports of these committees were discussed in the National Radar Council (for various equipment such as radars, navigational aids etc) and the Defence Electronics Committee (for various electronics equipment required by the defence services). Steps are now being taken to implement these recommendations.

With regard to consideration of import proposals from various users, in a number of cases new development, manufacture programmes were identified to meet long-term needs indigenously, as also maximum supply from indigenous sources was ensured in the limited context of particular import proposals.

As regards the major programme for manufacture of high-power microwave tubes being implemented by BEL (for manufacture) and the Defence Research and Development Organisation (for development of new tubes), the production for the tubes is expected to commence in the latter half of 1986-87. A programme profile has also been prepared for undertaking development of techniques, technologies and specific microwave tubes required by defence in future.

As part of the licensing function of the DoE, ten cases of industrial licences and approval of phase manufacturing programme in this sector were dealt with.

Control, Instrumentation & Industrial electronics

The introduction of HVDC technology for power transmission saw significant progress in India during the year. The experimental line project being undertaken in association with BHEL for linking Lower Sileru in Andhra Pradesh with Barsoor in Madhya Pradesh through a 100kV, 100MW HVDC transmission line registered significant progress. Simultaneously, efforts coupled with upgradation of capabilities in CEA and NTPC for system planning and engineering studies, acquisition of HVDC simulator at CPRI and initiation of seven R&D schemes for nucleating and nurturing advance level research and manpower training programmes at selected premier institutions have further strengthened the indigenous expertise for taking up the scheduled introduction of commercial HVDC lines planned in the Seventh Plan period.

The indigenous industry has geared itself to meet the automation, control and instrumentation requirement of power and process industries sectors for improving the productivity and reliability of operations. DoE had dialogues with the indigenous manufacturers and users in order to promote an increasing contribution of indigenous units in meeting the user requirements of uninterrupted power supplies, disturbance analysers, supervisory control and data acquisition systems, digital distributed control, instrumentation, etc.

Wherever possible, the concept of pooling of resources was promoted to make optimum use of available resources and technology. In this regard, a consortium of local manufacturers is now undertaking the automation of the seventh blast furnace of Bhilai steel plant providing for a major step up in technological advancement.

Efforts are also underway to promote developmental work in gap areas of instrumentation systems for the power sector and kindle interest in premier research institute in the identification and taking up this activity. Dialogue in this regard has been initiated with Central Power Research Institute, Bangalore. Small-scale and medium-scale industries have been supported for the manufacture of electronic pollution control equipment required during the Seventh Plan.

DoE, in association with the Department of Power and NTPC, is evaluating the possibilities of taking up of total modernisation and automation of an existing power plant to demonstrate the effectiveness of electronic techniques to increase plant efficiency.

Among significant developments in power electronics, the single- to three-phase converter developed for the Railways by CEERI, Pilani is poised for large-scale application with the completion of first phase field trials.

In association with the Railways, other applications in thyristor locomotives, chopper for EMUs, signalling and telecom systems also took a quantum jump during the year.

The advantages of AC drives in lieu of DC drives which has been made possible due to developments in power electronics are being actively promoted through interaction with industry and users.

Test and measuring instruments

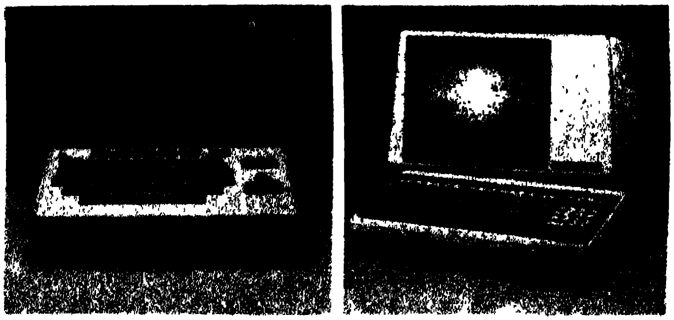
Test and measuring instruments manufactured in the country today are of varying sophistication and systems. Starting with a simple multimeter, frequency counter, etc, complex equipment like logic analysers and automatic test instruments are being manufactured in the country.

The working group on test and measuring instruments for the Seventh five-year Plan has estimated that the demand of test and measuring instruments in 1985-86 would be worth Rs 1250 million and that in 1986-87 would be worth Rs 1450 million. In the terminal year of the Seventh five-year Plan (1989-90) the figure is Rs 2500 million. Against this, the expected production figures are respectively Rs 650 million, Rs 800 million and Rs 1500 million. It will thus be observed that there is a wide gap between demand and production.

During the year 1985-86, four letters of intent have been issued for the manufacture of various types of test and measuring instruments. Notable items are PCM testing equipments.

Computers

The revised computer policy announced on November 19, 1984 has laid emphasis on indigenous manufacture of computers, computer peripherals and allied products of the latest technology at prices comparable with international levels and bring about increase in indigenisation. To achieve these objectives, revised guidelines have been formulated for licensing small-scale approvals in these areas:



1. These areas have been opened to all Indian companies having foreign equity up to 40 per cent.

2. The capacities are considered in terms of values in proportion to the level of investment on plant and machinery. The approach has been adopted to ensure better quality production equipment development tool, the deployment of which becomes more viable with the increase in the level of production.

3. To bring about rapid technological advancement, liberal import of design and drawing has been allowed. Foreign collaboration proposals are considered on merit involving equity participation, lumpsum knowhow fee and royalty.

4. Special waiver under Sections 21 and 22 of the MRTP Act have been provided to encourage investment.

5. The list of OGL items has been enlarged to provide for the import of computer peripherals which are not likely to be

indigenously available in the near future.

The above measures have evinced interest of the reputed computer manufacturers and of NRIs to join hand with their Indian counterparts to produce the computers and computer peripherals. The number of approvals (letters of intent/industrial licences or small-scale approvals) in the area of minicomputer/microprocessor-based system have increased to more than 300 units from a level of 150 units during last year. A number of foreign collaborations have been approved for minicomputer/microcomputers, computer peripherals including special equipment like MICR encoders, readers, sorters for banking application. To bring about standardisation in these areas, an attempt has been made and model specifications have been drawn for 8-bit range of personal computers.

The Department of Electronics has initiated steps for setting up of a Centre for the Development and Production of Computer Mainframes with a view to attaining self-reliance in the vital application areas such as defence, power, oil and steel. Electronics Corporation of India (ECIL) which has been entrusted with the responsibility of initiating the project has already taken the necessary steps for acquiring land and construction of the building. The collaboration agreement with Control Data Corporation for the manufacture of the Cyber 810 and 830 systems has been agreed by the government. Accordingly, ECIL is expected to place orders for capital equipment and depute engineers for the training. An investment of Rs 350 million has been approved for the project.

Exports

Exports are being accorded the highest priority by the government. Electronics has been identified as one of the areas having large potential for exports from India. Keeping this in view, an ambitious target of Rs 10,000 million has been framed for the terminal year of Seventh five-year Plan. Rs 3000 million would be achieved from exports of computer software and Rs 2000 million from system engineering and consultancy services and the rest would come from export of hardware equipment and components. The fulfilment of the above targets would call for sustained and coordinated efforts on several fronts.

To enable the software export to take a quantum jump, software exports has been permitted through satellite based data links with overseas computers. This provision of computer software export through satellite link will promote the establishment of software export technology parks. A number of approvals have been issued. These software export technology parks will function as mini export processing zones. A park will have a satellite earth station in its premises for directly exporting the computer software over the satellite data link. OCS will control, operate and maintain the satellite earth station. The Department of Electronics will act as a coordinator and will be fully responsible for its operation.

Growth

In the Seventh five-year Plan, electronics industry is targetted to grow at an average annual growth rate of 35 per cent with terminal year (1989-90) production at Rs 108,600 million. The expected contribution of the various sectors of the electronics industry during the terminal year (1989-90) of the Seventh Plan is as follows:

Sector	**Plan production (in Rs million)**
Components	21,000
Consumer Electronics	20,000
Communication	31,000
Broadcasting	2400
Aerospace & Defence	5400
Control, Instrumentation & Industrial Electronics	20,100
Computers & Office Equipment	8700
	108,600

Current innovations

Major innovative changes in electronics industry technology that have occurred during the past two to three years are given below. These changes will have far reaching effects on the operation of industrial sectors and hence on the economy:

(a) **Memories:** IBM Corporation announced the 512kB random access memory, the largest RAM capacity yet achieved.

(b) **High Voltage ICs:** 200-volt logic and control chips may soon be challenged by 400-volt chips.

(c) **Communications:** Long distance fibre-optic systems with a capacity of 140 to 432 megabit per second are coming on line. Talks of one gegabit per second have begun.

(d) **Satellite Communications:** Millimetre wave (about 12 GHz) systems will permit the use of much smaller antennae for direct broadcast satellites and other applications.

(e) **Medical Electronics:** Electrical and stimulation systems enable selected victims of spinal-cord paralysis to stand, walk and ride a modified tricycle.

(f) **Power Energy:** Several high-voltage DC long lines and ties between asynchronous AC systems were put into operation.

(g) **Industrial Electronics:** Assembly by robot of up to 15 components per minute at a precision of 25 micrometres is now possible.

(h) **Software:** Knowledge-based systems are finally coming into actual use.

(i) **Personal Computers:** Compatability is now a major goal of personal computer design.

(j) **Instrumentation:** Disagreements on how best to test high-speed, high-pin-count, very large-scale integrated chips are forcing manufacturers to break new ground in tester architecture. □

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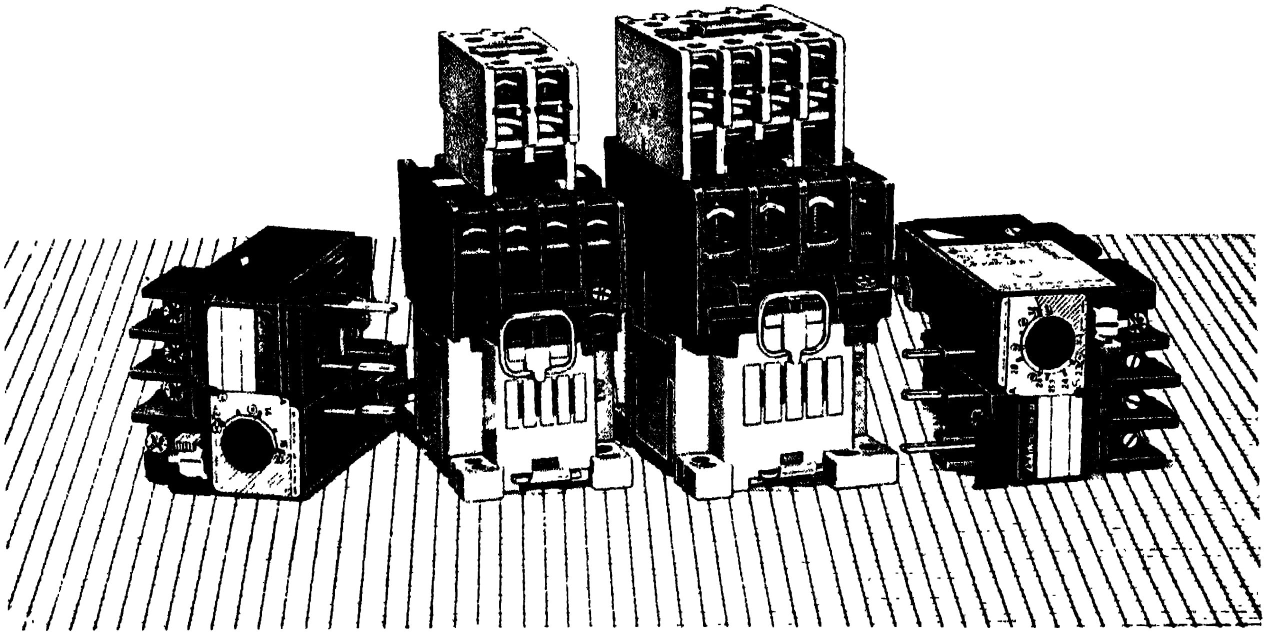

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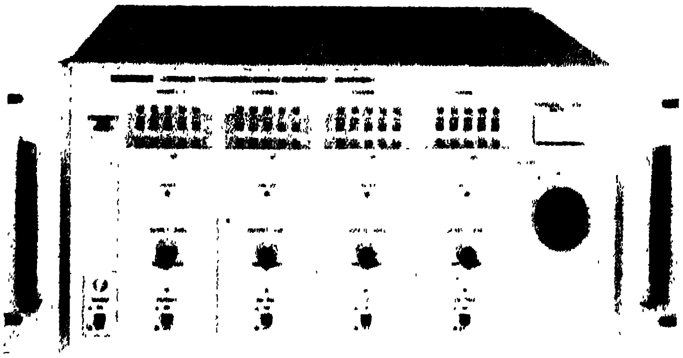

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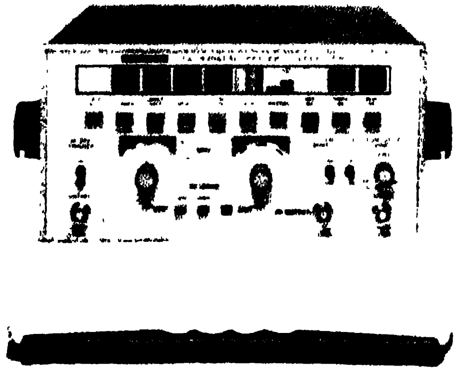

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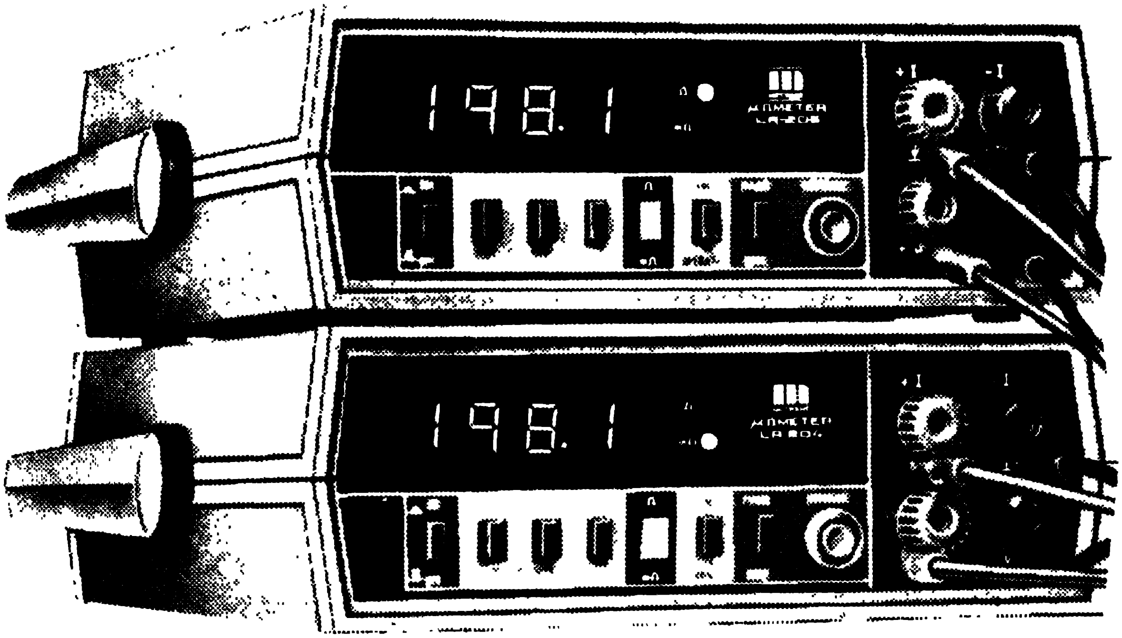

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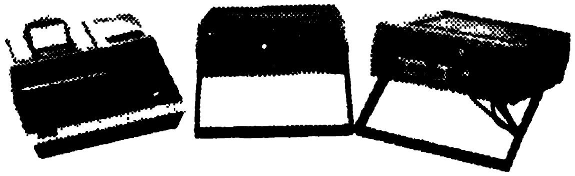

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Computer Corner

New chip for improved IBM-PC performance

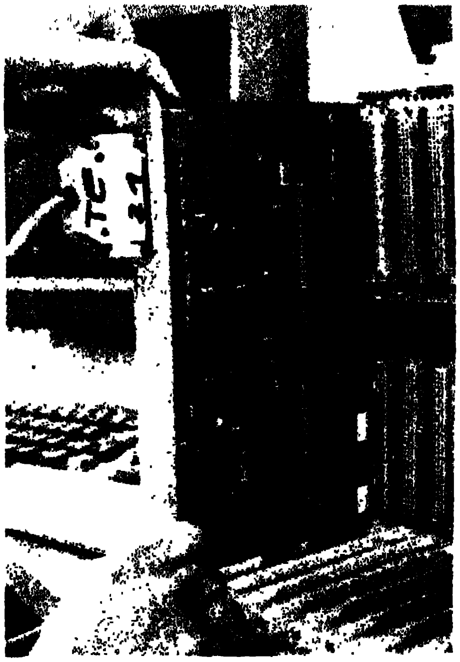
Nippon Electric Corporation [NEC] has introduced V-series microprocessors which can replace conventional processors, such as Intel's 8088 and 8086, to speed up both the PC and PC-XT without losing software compatibility. The V20 can be substituted in place of 8088 and V30 in place of 8086, without any fuss, by the owners of the computers themselves. The NEC chips are completely pin-compatible with the corresponding Intel processors.

'Benchmarking' tests have revealed a modest but appreciable improvements in floating-point calculation, prime number calculation, dBASE routine and 1-2-3 routine after substitution in PCs. Integer counts, table look-up and compiler routine tests also showed noticeably better performance with V20. Even better improvements are noticed in the performance of computers in which 8086 chips are replaced by V30.

In general, significant improvement is observed for mathematically oriented software after replacement of the original Intel chips while a modest but noticeable improvement occurs for general programs. The new chips should also work in all true IBM PC compatibles without any problem.

Upgradation of microcomputers by Siemens

The growing complexity of the programs in use often requires a memory address area which can only be obtained in simple fashion by 16-bit systems. To assist in upgrading to this new generation of microcomputers, Siemens offers the AMS-M7 board as a low-cost CPU. The new central processing unit features the SAB 8086 [8 MHz]. The board is geared for the 8087 math processor, the internal 80-bit structure of which enables complex mathematical computations to be handled with extreme accuracy.



Siemens' AMS-M7 board can be used as a low-cost CPU for the upgradation of microcomputers.

To enable slow peripheral boards to 'get used to' the 16-bit world, the AMS-M7 allows between 0 and 5 wait cycles to be set for cooperation on the local SMP bus. An on-board timer monitors the acknowledgement signal during data transfer via the AMS bus; the system is not blocked if a signal should be missing. The source is the SAB 8253 timer chip. Among the special features of the AMS-M7 are two SBX [single board extension] interfaces which enable a multitude of peripheral modules for extra memory, printers or monitors to be attached.

For user-developed control programs, the board can accommodate up to 64 kB of EPROM and 32 kB of RAM. The serial interface features the SAB 8251 programmable controller, which can be operated in both polling and interrupt mode. The chip permits both synchronous and asynchronous data transmission.

Integrated microprocessor-development system

The Universal Development Laboratory [UDL] embodies a 48-channel bus state analyser, an 8/16-bit universal emulator, an EPROM programmer and a programmable stimulus generator for debugging hardware and software of up to 36 different microprocessors. Integration of analyser, and emulation control in particular, is claimed to result in a very effective means of solving program flow problems.

The analyser can trigger on simple and complex events across all 48 channels and can be specified to occur following a combination of time delays or sequenced events. Selective tracing allows for the capture of only relevant information by specifying which ports, addresses or data ranges are recorded.

The emulator is available with up to 128k bytes of memory and its debugging software permits examination of target processor registers and RAM. It also allows the user to stop on preset break points and single-step the processor through complex algorithms. Since the target processor remains in its socket, timing problems which are common to other emulation equipment are avoided.

Stepping up computer production

The government has fixed a production target of Rs 24,400 million for the Seventh Plan period for computers and office equipments [personal home computers, wordprocessors etc] and to achieve production turnover of about Rs 8700 million by the terminal year 1989-90.

Of the 101 companies which have been given the letters of intent/industrial licences up to December 1985 for the manufacture of computers, 22 units are in production. Some of the prominent companies are: [1] Ambalal Sarabhai Enterprises Ltd, Baroda; [2] Andhra Pradesh Electronics Dev. Corpn Ltd, Hyderabad; [3] Auto Control Pvt Ltd, New Delhi; [4] Bharat Heavy Electricals Ltd, Bombay; [5] Bihar State Electronics Dev. Corpn Ltd, Patna; [6] Electronic Corpn of Tamilnadu Ltd, Madras; and [7] Kerala State Electronics Dev. Corpn Ltd, Trivandrum.

Letters of intent/industrial licences of the remaining companies are at various stages of implementation.

Computer software production and export

Computer software export is fetching India just a third of what it can. According to Mr Sitansu Kumar Basu, director, International Data Management Limited, successor to IBM, a software exporter today sends out his trained personnel to work at the importer's premises abroad to design and offer the software. This proved costly to the Indian exporter. If after a trip to the importer's premises, the Indian technician is allowed to design the entire software in India and export it, the realisation could be three times than the present earnings.

The government has also taken steps to promote the development of computer software. These include integrated policy measures in electronics; new computer policy; and the plans of the Department of Electronics to establish software development agency to promote the integrated growth of computer software industry for export as well as domestic markets.

Computer software marketed during 1985-86, the beginning of Seventh Plan, may be estimated at Rs 950 million, and during 1989-90 around Rs 6500 million, including the turnover of computer software for exports.

Mr Basu feels that computer research in India would still be prone to limitations since Indian researchers feel very much at home abroad, while that environment is still not available here.

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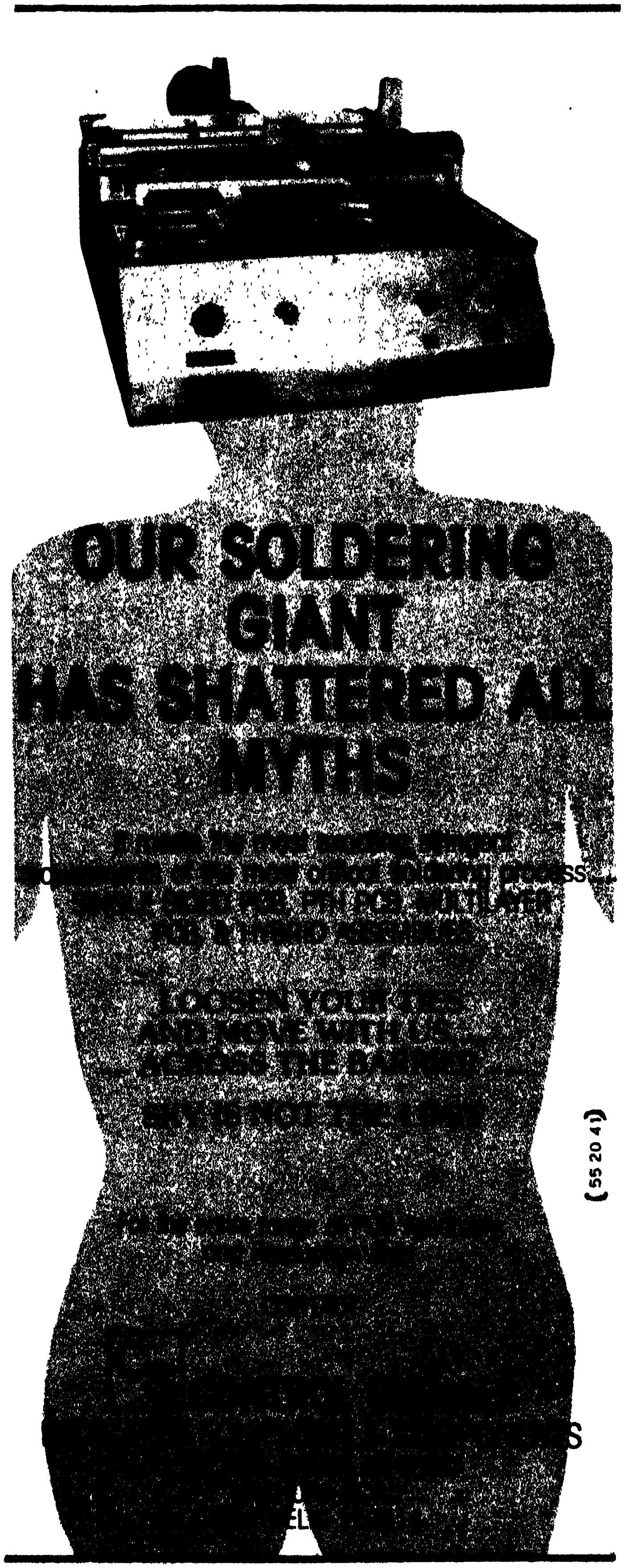


Ajay Chikersal

Multiple Program Timer Using Sinclair Spectrum Micro

Give your Spectrum real power to control external electrical gadgets with this circuit. This construction project turns your Spectrum into a multiple program timer. To put it simply, it is a programmable switch set with respect to time.

Let's consider a practical application of this project: You might encounter a situation when you find yourself awfully busy in appointments you cannot cancel and would not like to miss your favourite radio programmes either. To solve this problem all you have to do is 'run' the BASIC program, connect the interface unit, set your two-in-one on PLAY-REC and leave home happily.

The above is just one of the many applications this project can be put to; the limit is due only to one's imagination. With the right choice of components you will be able to control almost any electrical device.

The project has been designed to provide control for a minimum duration of a minute, but can be easily modified to provide duration of a few seconds. The main effort has been to provide an inexpensive circuit, a simple interface through the cassette port and sure success.

To explain how this project works we should consider

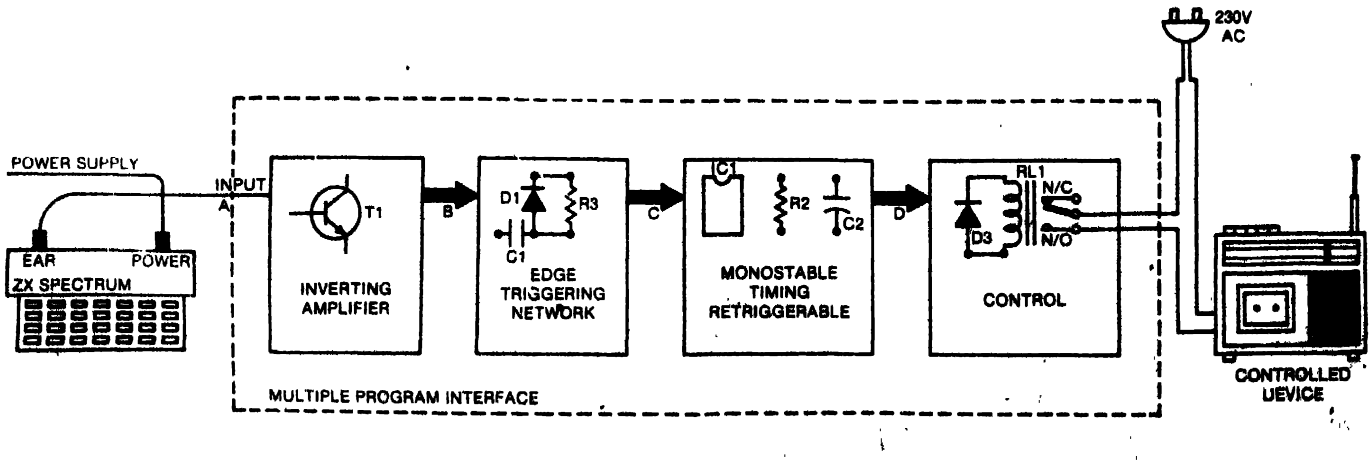
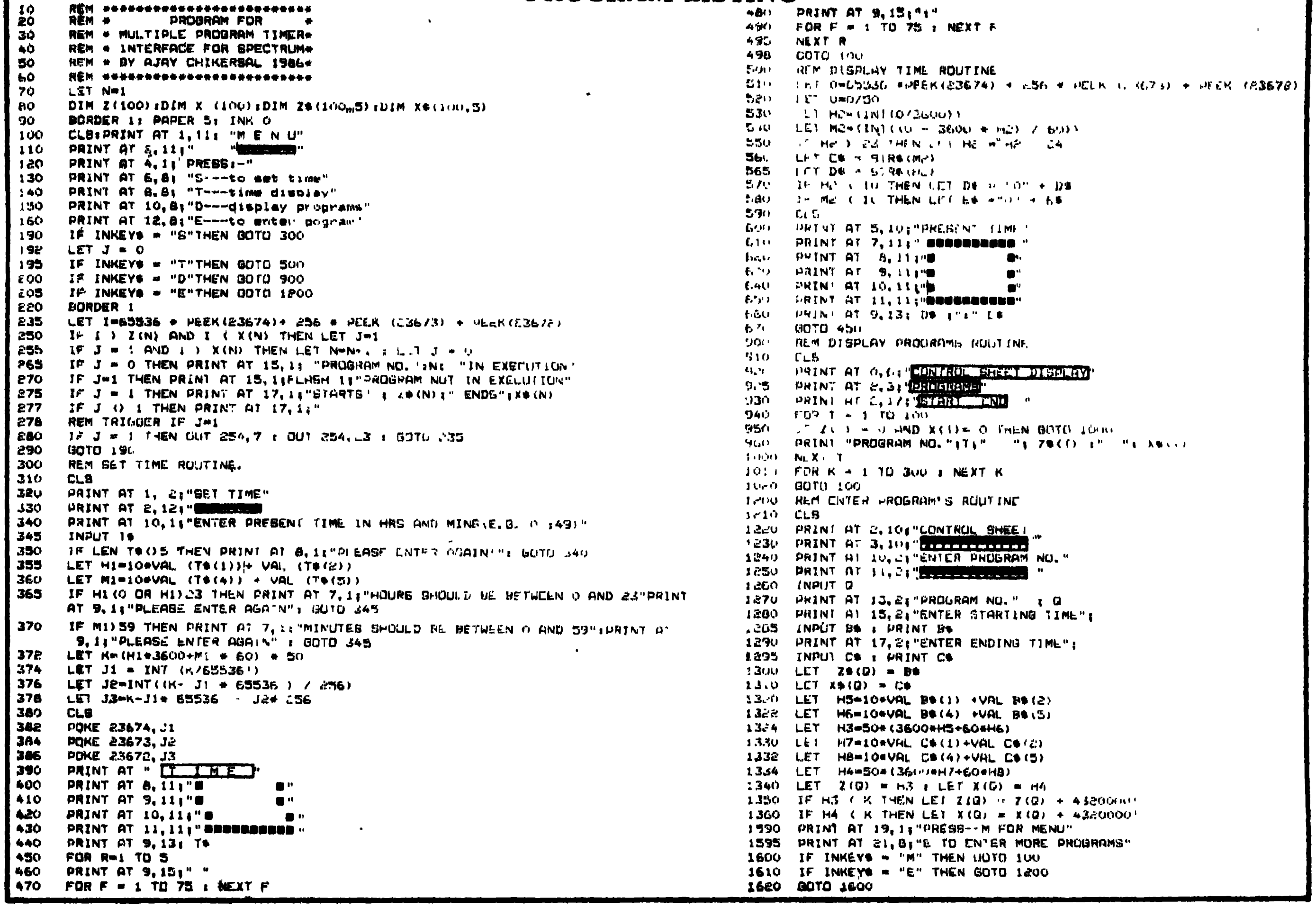


Fig. 1: Block diagram of the entire system.

PROGRAM LISTING



```
10     REM ***************************
20     REM *       PROGRAM FOR       *
30     REM * MULTIPLE PROGRAM TIMER*
40     REM * INTERFACE FOR SPECTRUM*
50     REM * BY AJAY CHIKERSAL 1986*
60     REM ***************************
70     LET N=1
80     DIM Z(100):DIM X (100):DIM Z$(100,5):DIM X$(100,5)
90     BORDER 1: PAPER 5: INK 0
100    CLS:PRINT AT 1,11; "M E N U"
110    PRINT AT 2,11;"     "■■■■■■"
120    PRINT AT 4,1;"PRESS:-"
130    PRINT AT 6,8; "S---to set time"
140    PRINT AT 8,8; "T---time display"
150    PRINT AT 10,8;"D---display programs"
160    PRINT AT 12,8;"E---to enter pogram"
190    IF INKEY$ = "S"THEN GOTO 300
192    LET J = 0
195    IF INKEY$ = "T"THEN GOTO 500
200    IF INKEY$ = "D"THEN GOTO 900
205    IF INKEY$ = "E"THEN GOTO 1200
220    BORDER 1
235    LET I=65536 * PEEK(23674)+ 256 * PEEK (23673) + PEEK(23672)
250    IF I ) Z(N) AND I ( X(N) THEN LET J=1
255    IF J = 1 AND I ) X(N) THEN LET N=N+1 : LET J = 0
265    IF J = 0 THEN PRINT AT 15,1; "PROGRAM NO. ";N; "IN EXECUTION"
270    IF J=1 THEN PRINT AT 15,1;FLASH 1;"PROGRAM NOT IN EXECUTION"
275    IF J = 1 THEN PRINT AT 17,1;"STARTS" ; Z$(N);" ENDS";X$(N)
277    IF J () 1 THEN PRINT AT 17,1;"
278    REM TRIGGER IF J=1
280    IF J = 1 THEN OUT 254,7 : OUT 254,23 : GOTO 235
290    GOTO 190
300    REM SET TIME ROUTINE.
310    CLS
320    PRINT AT 1, 2;"SET TIME"
330    PRINT AT 2,12;"■■■■■■■■
340    PRINT AT 10,1;"ENTER PRESENT TIME IN HRS AND MINS(E.G. 0 ;49)"
345    INPUT T$
350    IF LEN T$()5 THEN PRINT AT 8,1;"PLEASE ENTER AGAIN!": GOTO 340
355    LET H1=10*VAL (T$(1))+ VAL (T$(2))
360    LET M1=10*VAL (T$(4)) + VAL (T$(5))
365    IF H1(0 OR H1)23 THEN PRINT AT 7,1;"HOURS SHOULD BE BETWEEN 0 AND 23"PRINT
       AT 9,1;"PLEASE ENTER AGAIN"; GOTO 345
370    IF M1)59 THEN PRINT AT 7,1;"MINUTES SHOULD BE BETWEEN 0 AND 59":PRINT AT
        9,1;"PLEASE ENTER AGAIN" : GOTO 345
372    LET K=(H1*3600+M1 * 60) * 50
374    LET J1 = INT (K/65536)
376    LET J2=INT((K- J1 * 65536 ) / 256)
378    LET J3=K-J1* 65536  - J2* 256
380    CLS
382    POKE 23674,J1
384    POKE 23673,J2
386    POKE 23672,J3
390    PRINT AT " T I M E "
400    PRINT AT 8,11;"■         ■"
410    PRINT AT 9,11;"■         ■"
420    PRINT AT 10,11;"■         ■"
430    PRINT AT 11,11;"■■■■■■■■■■■"
440    PRINT AT 9,13; T$
450    FOR R=1 TO 5
460    PRINT AT 9,15;" "
470    FOR F = 1 TO 75 : NEXT F
480    PRINT AT 9,15;":"
490    FOR F = 1 TO 75 : NEXT F
495    NEXT R
498    GOTO 100
500    REM DISPLAY TIME ROUTINE
510    LET O=65536 *PEEK(23674) + 256 * PEEK (23673) + PEEK (23672)
520    LET O=O/50
530    LET H2=(INT(O/3600))
540    LET M2=(INT((O - 3600 * H2) / 60))
550    IF H2 ) 23 THEN LET H2 = H2 - 24
560    LET E$ = STR$(M2)
565    LET D$ = STR$(H2)
570    IF H2 ( 10 THEN LET D$ = "0" + D$
580    IF M2 ( 10 THEN LET E$ ="0" + E$
590    CLS
600    PRINT AT 5,10;"PRESENT TIME"
610    PRINT AT 7,11;" ■■■■■■■■■■ "
620    PRINT AT 8,11;"■         ■"
630    PRINT AT 9,11;"■         ■"
640    PRINT AT 10,11;"■         ■"
650    PRINT AT 11,11;"■■■■■■■■■■■"
660    PRINT AT 9,13; D$ ;":" E$
670    GOTO 450
900    REM DISPLAY PROGRAMS ROUTINE
910    CLS
920    PRINT AT 0,6;"CONTROL SHEET DISPLAY"
925    PRINT AT 2,3;"PROGRAMS"
930    PRINT AT 2,17;"START   END   "
940    FOR T = 1 TO 100
950    IF Z(T) = 0 AND X(T)= 0 THEN GOTO 1000
960    PRINT "PROGRAM NO.";T;"    "; Z$(T) ;"    "; X$(T)
1000   NEXT T
1010   FOR K = 1 TO 300 : NEXT K
1020   GOTO 100
1200   REM ENTER PROGRAM'S ROUTINE
1210   CLS
1220   PRINT AT 2,10;"CONTROL SHEET
1230   PRINT AT 3,10;"■■■■■■■■■■■■■"
1240   PRINT AT 10,2;"ENTER PROGRAM NO."
1250   PRINT AT 11,2;"■■■■■■■■■■■■■■ "
1260   INPUT Q
1270   PRINT AT 13,2;"PROGRAM NO."  ; Q
1280   PRINT AT 15,2;"ENTER STARTING TIME";
1285   INPUT B$ : PRINT B$
1290   PRINT AT 17,2;"ENTER ENDING TIME";
1295   INPUT C$ : PRINT C$
1300   LET  Z$(Q) = B$
1310   LET X$(Q) = C$
1320   LET  H5=10*VAL B$(1) +VAL B$(2)
1322   LET  H6=10*VAL B$(4) +VAL B$(5)
1324   LET  H3=50*(3600*H5+60*H6)
1330   LET  H7=10*VAL C$(1)+VAL C$(2)
1332   LET  H8=10*VAL C$(4)+VAL C$(5)
1334   LET  H4=50*(3600*H7+60*H8)
1340   LET  Z(Q) = H3 : LET X(Q) = H4
1350   IF H3 ( K THEN LET Z(Q) = Z(Q) + 4320000
1360   IF H4 ( K THEN LET X(Q) = X(Q) + 4320000
1590   PRINT AT 19,1;"PRESS--M FOR MENU"
1595   PRINT AT 21,8;"E TO ENTER MORE PROGRAMS"
1600   IF INKEY$ = "M" THEN GOTO 100
1610   IF INKEY$ = "E" THEN GOTO 1200
1620   GOTO 1600
```

both software and hardware parts of it.

Software

In the software part, we have the BASIC program as given in the program listing Table. The program essentially works with respect to time set by the user, activating and deactivating the device in accordance with the programs set by the user. The program generates trigger pulses whenever the device has to be activated. This is achieved by the simple BASIC commands

OUT 254,7
AND OUT 254,23

The only other curious thing about this program is the

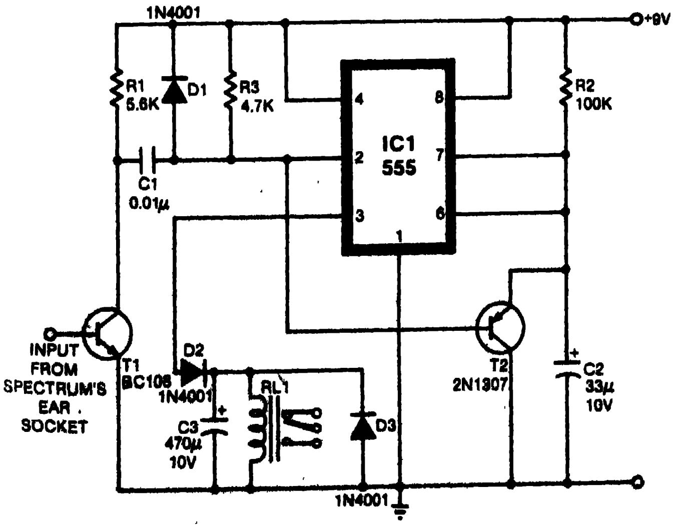


Fig. 2: Circuit diagram of the interface.

PARTS LIST

Semiconductors:	
IC1	— NE555 timer
T1	— BC108 npn transistor
T2	— 2N1307 pnp transistor
D1-D3	— 1N4001 rectifier diode
Resistors (all ¼watt,±5% carbon):	
R1	— 5.6-kilohm
R2	100-kilohm
R3	- 4.7-kilohm
Capacitors:	
C1	— 0.01µF ceramic disc
C2	— 33µF, 10V electrolytic
C3	— 470µF, 10V electrolytic
Miscellaneous:	
RL1	— 9-volt relay
	— PCB, IC socket, flexible wire, small enclosure, EP jack etc.

utilisation of the Spectrum's internal clock by using the BASIC PEEK and POKE functions.

Three memory locations: 23674, 23673 and 23672 are reserved by the computer to maintain and run the clock. The clock runs all the time, independent of program control.

The clock works precisely like this: The byte stored at location 23672 increments 1/50th of a second when incremented from 255. It resets to 0 and automatically increments the byte stored at 23673 by 1, which in turn when reset to 0, increments the byte stored at 23672 by 1.

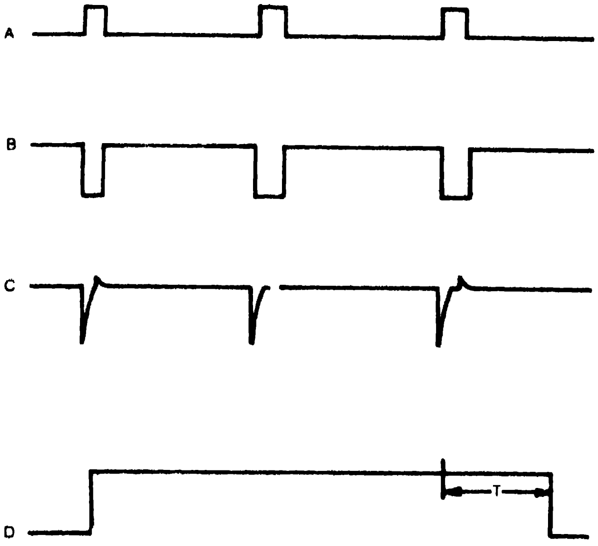


Fig. 3: Wave forms at different stages in block diagram.

To set the time we first find the fiftieths of a second contained in the time. This is given by the expression:

Time (in fiftieths of a second)=(Hrs×3600+Mins×60)×50

This time is then broken into three more numbers - A,B and C -as given by the relation below:

Time=65536×A+256×B+C

These three numbers are then stored successively in the locations 23674, 23673 and 23672.

```
POKE 23674,A
POKE 23673,B
POKE 23672,C
```

To find the present time, we apply the formula given below:

Time (fiftieths of a second) = 65536 × PEEK (23674) + 256 × PEEK (23673) + PEEK (23672)

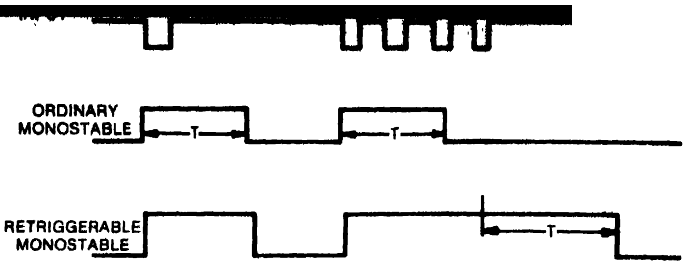


Fig. 4: Typical waveform of a retriggerable monostable.

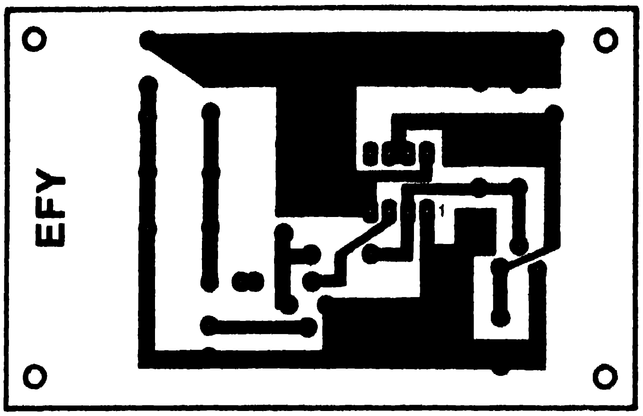


Fig. 5: PCB layout for the interface.

According to the Sinclair BASIC manual this method gives accuracy to about 0.01%, i.e. a disparity of 10 seconds per day. However, triggering by the use of the OUT instruction may make the clock loose time. One can experiment and perhaps design a better clock system. If this idea is used in any other BASIC program, the use of BEEP command and cassette operations (i.e. LOAD and SAVE) should be avoided while the program is in execution, as these will definitely slow down the clock.

All one has to remember while using the program is that a 24-hour clock is being used, i.e. time must be between 00:00 and 23:59, and that all the inputs of the MENU assume use of upper-case mode. So one shouldn't forget to CAPS LOCK before running the program.

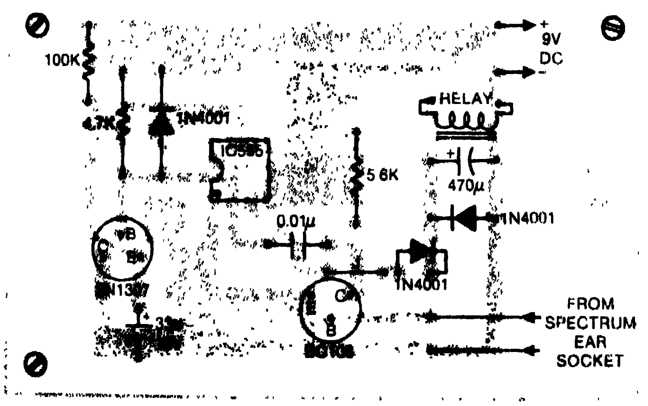


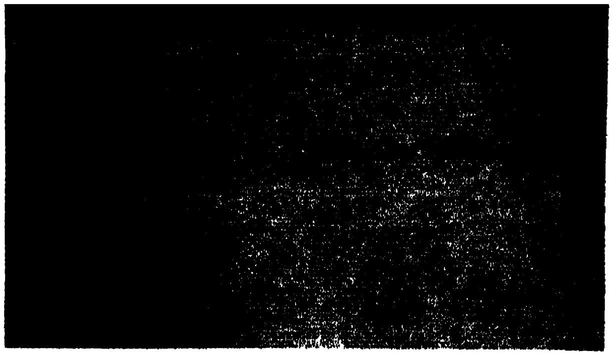
Fig. 6: Components layout for the PCB.

Hardware

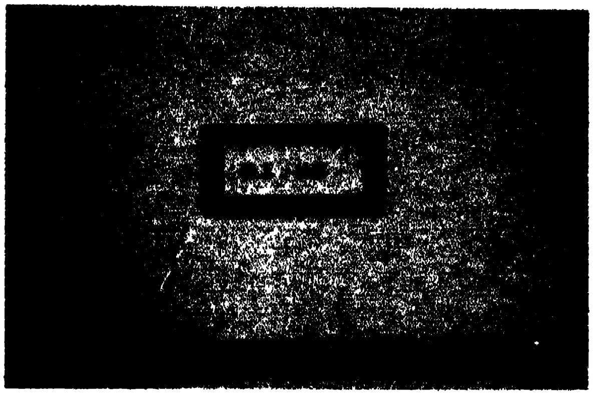
The heart of this project is once again the ever so popular NE555 timer chip. In this project it is configured as a retriggerable monostable.

The circuit consists essentially of four simple parts. The first part is an inverting amplifier which amplifies the feeble trigger pulses from Spectrum produced by the OUT instruc-

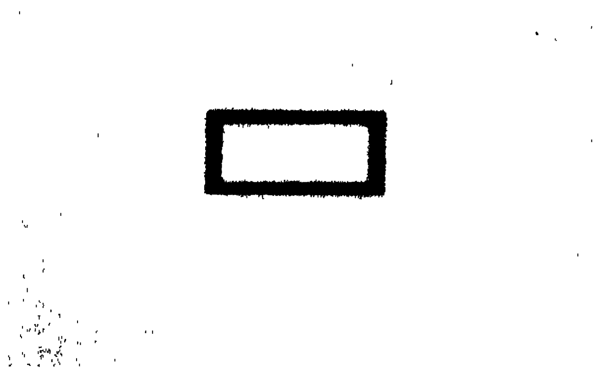
(a) The options in the menu.



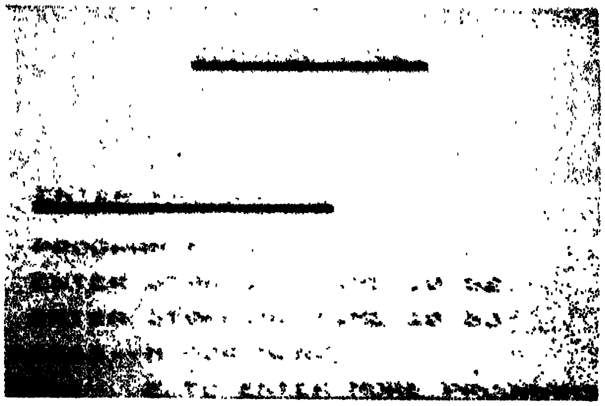
(b) 'S' Selected to set time.



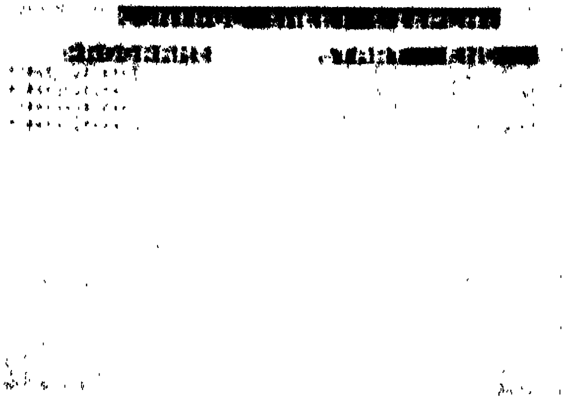
(c) Time displayed automatically after being set



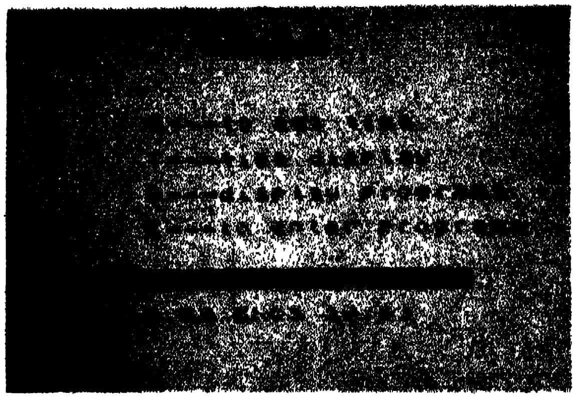
(d) 'T' Selected to show the present time.



(e) 'E' Selected to enter the programme.



(f) 'D' Selected to verify the list of programs entered.



(g) Typical display for menu when a program is being excecuted.

Fig. 7: Various modes of the BASIC program.

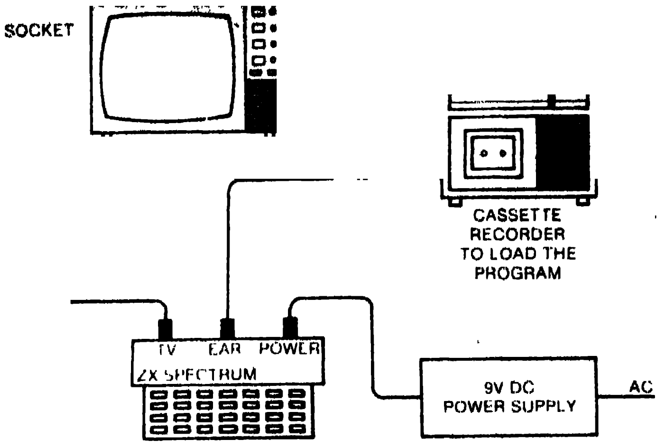


Fig. 8(a): Initial set up to load the program.

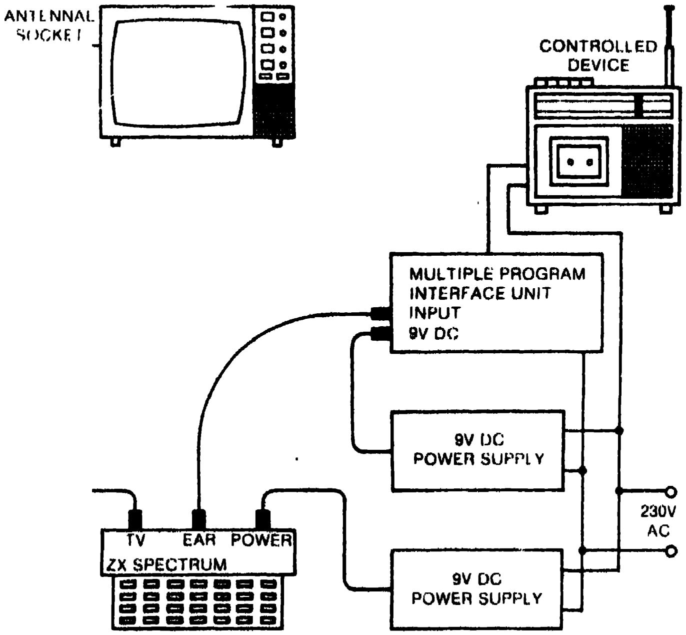


Fig. 8(b): Final set up to activate the device.

tion. The second part ensures edge triggering of the monostable with the help of the network comprising resistor R3, capacitor C1 and diode D1. The third part has the monostable with timing components, resistor R2 and capacitor C2.

The time period of this monostable is given by

$T=1.1\times R2\times C2$

In this circuit (Fig. 2) R2=100-kilohm and C2=33 µF. Hence, the time period is equal to

$T=1.1\times 100\times 10^{3}\times 33\times 10^{-6}$

$=3.63$ seconds.

If one wants to control the external device for a duration of few seconds, the value of the timing components R2 and C2 could be changed to decrease the time period. One could also make changes in the BASIC program so that trigger pulses occur more frequently.

This part also consists of the retriggerable configuration made possible by transistor T2. In an ordinary monostable the 555, once triggered, continues till the time period runs out. In this application it is essential to extend the time period as per time set by the user. This is achieved by the shown in Fig. 2. Each input pulse will discharge C2 to about 1 volt. (In the normal operation C2 is discharged to about 0.2 volts). So, the retriggered time period will be slightly slower than the normal period.

Waveforms for both the normal and the retriggerable monostables are given in Fig. 4, for comparison.

The last but the most important part of the circuit is that of control. Once triggered, the 555 drives the relay directly. One can choose the relay depending upon the current and power requirements of the external device.

After having gone through the entire process, let's now have a clear and concise overview of the whole process by referring to Fig. 1.

First, the Spectrum generates trigger pulses at the right time and for the right duration which are inverted, amplified and fed to the input of the monostable. Since the input pulses occur faster than the time period of the monostable, it is retriggered and the output pulse indicates only the start and end of the train of input pulses. This output is then fed to the relay which controls the external device.

The waveforms at different points in the block diagram are shown in Fig. 3.

Setting up

Type in the BASIC program. Run it, and observe the options available on the MENU. Study Fig. 7 carefully which shows various frames that appear on TV when you RUN the program. You are first expected to set the present time, after which you can set the programs for the day. Having set the options, you can now return back to MENU, connect the interface unit to Spectrum via the EAR socket, switch it on and go about your important business, trusting the spectrum to do the rest faithfully, unmanned.

The 'setting-up' is also illustrated pictorially in Fig. 8 for clear understanding.

Typing on the keys also generates trigger pulses. So, it is advisable to turn the interface unit 'ON' only after you are satisfied with entries of present time and programs for the day. The MENU gets locked (i.e. the options are not available) during the execution of any one program. To extend the facility of 'choosing options' to all the routines, all you have to do is retype the BASIC program line 280 in all the routines.

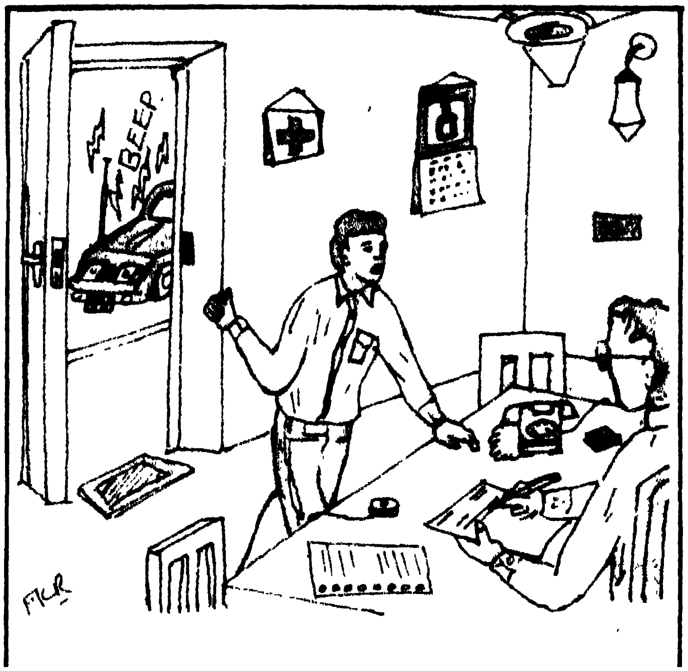
The variable 'J', as used in this program, is used to indicate the state of control. Logically, J=0 indicates the 'OFF' state and J=1 indicates the 'ON' state.

Some other applications of this project could be to control the cassette recorder through the remote socket to have a more effective filing control; to use it as an anti-theft device for switching on and off the lights of your house during your absence, indicating occupancy, to any prospective burglar; to keep your dinner warm by controlling the hot plate; if you have a small water pump handy, it could water your plants during your vacation.

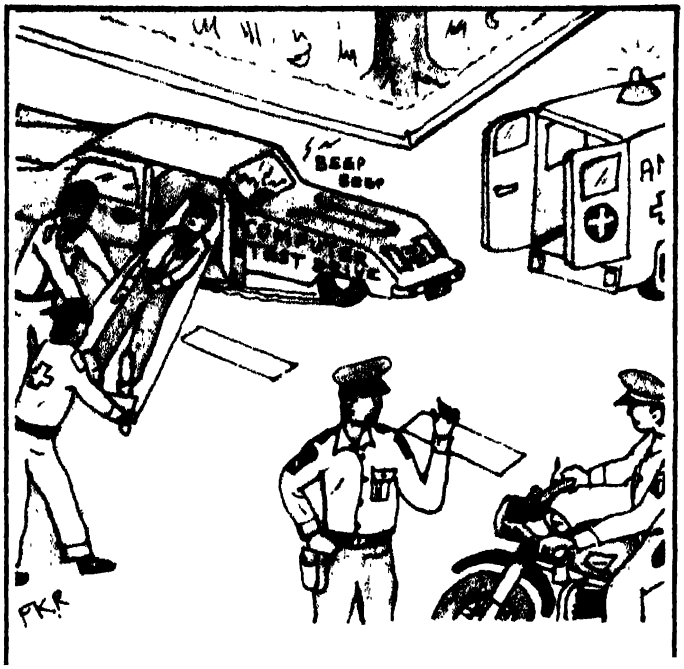
□

Electroons

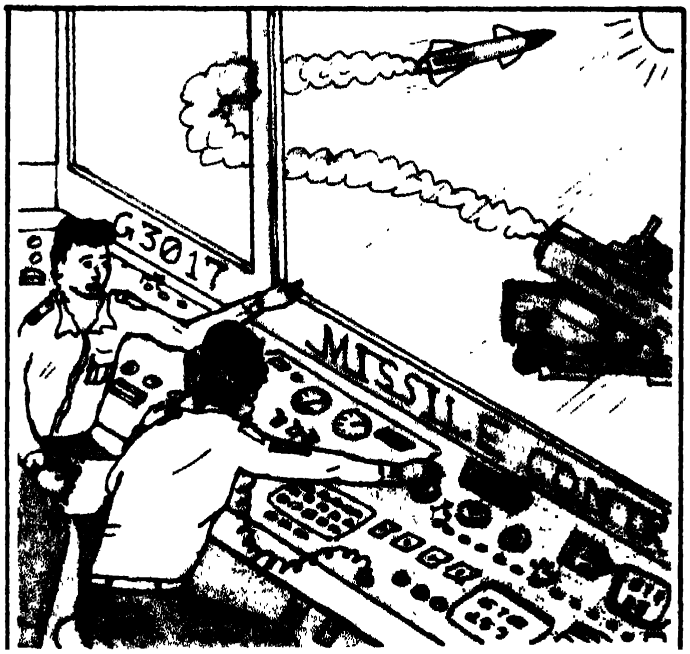
By Prasanto Kumar Roy



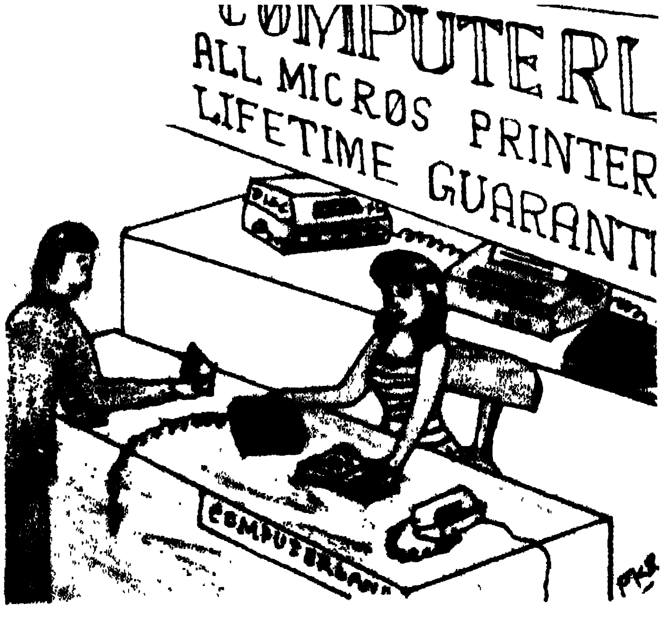
"Doctor, you've got to help me! I've caught a cold, and my car's computer refuses to recognise my voice. It sounds the burglar alarm whenever I speak to it now!'



"Fractured skull...seems he was going at 200 kmph when his car's computer detected an ant crossing the road, and locked all the brakes on."

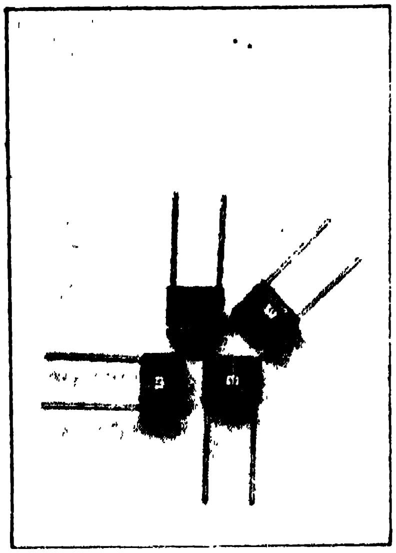


"Well, at least the microchips they've supplied for these heat-seeking missiles this time are working. Whichever way we launch a missile now, it turns towards the sun!"



"Yes, sir, I know our computers always carry unconditional lifetime guarantees, but I'm sorry, sir, we can't replace this micro of yours... obviously, its lifetime period is quite over!"

ANOTHER WINNER



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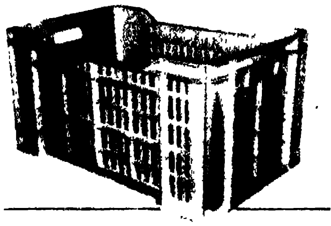

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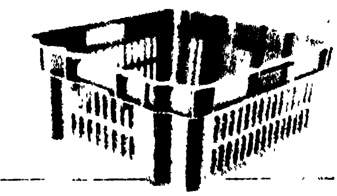
OUTER	542	360	292

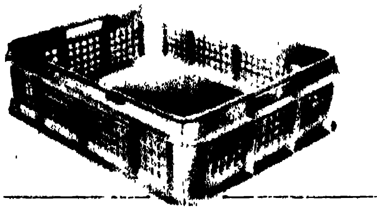
2975



PERFORATED SQUARE CRATE

DIMENSIONS IN MM	L	B	H
INNER	410	410	170
OUTER	460	430	175

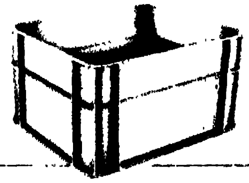
2989



PERFORATED TUB POUCH CRATE

DIMENSIONS IN MM	L	B	H
INNER	427	335	124
OUTER	471	378	137

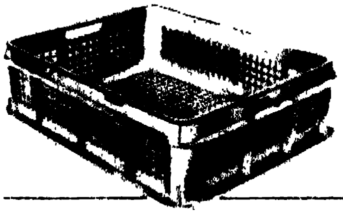
2982



CLOSE CRATE MEDIUM

DIMENSIONS IN MM	L	B	H
INNER	412	332	229
OUTER	445	364	241

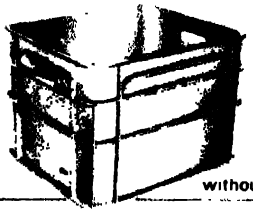
2990



BOTTOM PERFORATED TUB POUCH CRATE

DIMENSIONS IN MM	L	B	H
INNER	427	335	124
OUTER	471	378	137

2981



Also without handle

CLOSE CRATE BIG

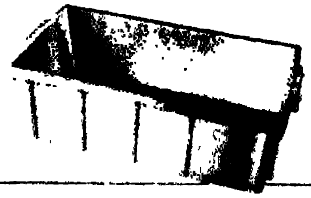
DIMENSIONS IN MM	L	B	H
INNER	416	335	304
OUTER	445	364	312

1685

SQUARE TRAY 85

DIMENSIONS IN MM	L	B	H
INNER	345	250	80
OUTER	375	280	85

2971



MINI CRATE

DIMENSIONS IN MM	L	B	H
INNER	394	200	133
OUTER	438	222	137

2912

For 12 bottles
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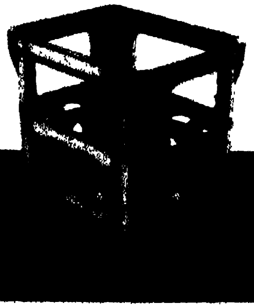
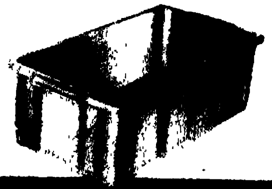
up to 285 mm height
up to 80 mm diameter



BEER BOTTLE CRATE

DIMENSIONS IN MM	L	B	H
INNER	340	265	300
OUTER	365	280	315

2974



MIDY CRATE

DIMENSIONS IN MM	L	B	H
INNER	360	240	145
OUTER	390	270	150

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Comparative Study of Computer Languages

Input, Output Statements (2)

Part XI

R. Ramaswamy

In COBOL we can enter the data in the program in two ways. One is through the console typewriter and the other through data files. Of course, we can enter data as part of the program by means of assignment statements. In this article, we shall consider the instructions to perform the input/output operations through the console and the printer respectively. Later we shall consider how data can be entered and output through files. When we write files, we mean only computer files, i.e., the floppy diskette medium.

Instructions for entering data through the console

Just as we have the READ-FORMAT pair of statements in FORTRAN for entering data through the console, we have the ACCEPT statement in COBOL for entering data through the console. The general form of the ACCEPT statement is

```
ACCEPT variable
```

Only one variable is accepted by one ACCEPT statement. When the computer encounters this statement, it stops and waits until the value of the variable is keyed through the console. If you want the values of ten variables to be entered through the console, the ACCEPT statement must be executed ten times. You cannot give the names of all the ten variables in the same ACCEPT statement. Thus there is a severe restriction on entering the data into the program by means of the ACCEPT statement. Remember that in FORTRAN a list can be entered through the console when the computer stops on encountering the READ statement. Suppose you want to enter the name of a person, you can write the ACCEPT statement as

```
ACCEPT NAME
```

The computer waits until the name is keyed through the console. One may ask whether there is any FORMAT statement as in the case of FORTRAN. Of course, the variable 'NAME' must have been completely described beforehand in a section called the WORKING-STORAGE SECTION. This is similar to the FORMAT statement in FORTRAN, though it is not called by the same name. Every variable that is to be read by the ACCEPT statement must have been described earlier by giving the level number and the nature and length of the data item.

We know that when data are independent, they are given the level number 77 in COBOL. Code letters are used to indicate the nature of the data item. The code '9' is used for numeric data, 'A' for alphabetic data and 'X' for alphanumeric data. The width of the data is represented by repetition of the code characters. If a numeric data item is to have a width of 4, then it is coded using four 9s. The location of the decimal point is indicated by putting the code letter 'V' in the required location. If the number is to be signed, then the letter 'S' is put at the left end of the code. For example, to tell the computer that an independent variable 'A' must store a number whose value is -789.65, it must be described as follows:

```
    77  A PIC S999V99
```

The number of digits can be less but not more. If the number is positive, the code letter 'S' is ignored. To represent an alphanumeric data of width 10 to be stored in the variable 'NAME', the description will be:

```
    77  NAME PIC X(10)
```

For pure alphabetic data the description of a variable, say, 'DESIGNATION', having a width of 15 will be:

```
    77  DESIGNATION PIC A(15)
```

Prior description of all variables is essential in COBOL but not so in FORTRAN.

Instructions for outputting result through printer or screen

Just as we have the WRITE-FORMAT pair of statements in FORTRAN for printing the result on paper, we have the DISPLAY statement in COBOL for printing the result on paper. The result also appears on the screen. The general form of the DISPLAY statement is:

```
    DISPLAY list
```

The list contains a list of one or more variables separated by commas or simply spaces. The total width of the items to be printed must not exceed one line width, i.e., 80 characters in the case of an 80-column printer. If you want to print the values of three variables whose values are 234, 435 and 567, you give the DISPLAY statement as

```
     DISPLAY A, B, C
```

The computer then prints the values as

```
    234435567
```

If you want to give a gap between the items you can give the statement as

```
    DISPLAY A, ' ', B, ' ', C
```

Now, one space will be left between two data items. If you also want to give the names of the variables, you can give the statement as

```
    DISPLAY 'A = ', A, 'B = ', B, 'C = ', C
```

The computer prints the result as

```
    A = 234 B = 435 C = 567
```

Strings are printed as enclosed within quotes. Suppose the variable 'X' stores a string 'KRISHNAMURTHY'. If you write

```
    DISPLAY X
```

The computer prints

```
    KRISHNAMURTHY
```

Remember that in COBOL all the variables should be completely described with regard to their nature, type and length.

Formats for input and output data

We said that every data item whether used during input or output must be described. These descriptions can be called the formats for the input data and the output data. Suppose you want to enter the data -0678.95 into the variable 'X', 'X' must be described with an input format as follows:

```
    77  X  PIC  S9999V99
```

For outputting the result, a different format must be given. Otherwise, the sign and the decimal point will not be printed. We would like the output to appear as -678.95. The format for the output field must be edited so as to give the result in a presentable form.

Sometimes the $ sign has to be added before a number. There may be many more editing features which we would like to have in business problems. In such cases, we have to give editing picture clauses for the output data items. Edited picture clauses can be given only to output data items and not input data items since a COBOL program cannot use edited data for manipulation purposes. We output the result only after all manipulations are over. In FORTRAN, the sign and the decimal point can be given in the input data. But in COBOL the sign and the decimal point cannot be given in the data. They are instead denoted by some codes in the format statements.

Need for editing output data

Suppose you have a program which calculates the total sales for a company. The item TOTAL-SALES should have been described as follows:

```
    77  TOTAL-SALES PIC 9(6)V99.
```

If, as a result of several calculations, the program has computed the value as 07458255 and you had given a DISPLAY statement as

```
    DISPLAY 'TOTAL-SALES =', TOTAL-SALES
```

the computer prints

```
    TOTAL-SALES = 07458255
```

Obviously, the above form is not meaningful. A far more desirable form would be:

```
    TOTAL-SALES = $ 74,582.55
```

In order to accomplish this transformation from the purely numeric form to the more familiar form including a dollar sign, a comma and an actual decimal point, and excluding the zeros, a COBOL process called EDITING is performed. This EDITING is done using some PICTURE characters to describe the output data items. Note that editing symbols must not be used for data items in the input file.

Editing symbols in COBOL

The following are some of the editing symbols used:

Z . $, + - CR DB * B 0

Let us now describe the function of each of these editing characters one by one.

The Z character

The Z symbol is called the zero suppression symbol character. It is used to suppress zeros in the non-significant places in a number. Numeric characters other than 0, embedded or trailing zeros, and signs are not affected by this zero suppression character. It is permissible to replace all the 9s in a numeric picture clause with Zs. Table I illustrates the functioning of the zero suppression character.

TABLE I

Input Field			Output Field		
Picture of the Item	Item Size	Stored Value	Picture of the Item	Item Size	Value Printed
9999	4	0007	9999	4	0007
9999	4	0007	ZZ99	4	07
9999	4	0007	ZZZZ	4	7
9999	4	4005	ZZZZ	4	4005

Decimal insertion character

In the input field, one must not put the actual decimal point in the picture clause but only indicate the location of the decimal point by putting the code letter 'V' in the location where the decimal point is required. The letter 'V' is said to be placed in the position of the assumed decimal point. In the output field, we would like to place the actual decimal point for being meaningful to the users. So in the output field, which is now said to be edited, we show the position of the decimal point by actually putting it in the desired position. Unlike the V character, the (.) character is counted in determining the field length. The decimal insertion character can be used in conjunction with the Z character. Table II illustrates the function of the decimal point insertion character.

TABLE II

Input Field			Output Field		
Picture of the Item	Item Size	Stored Value	Picture of the Item	Item Size	Value Printed
999V99	5	01234	999.99	6	012.34
999V99	5	01234	ZZZ.ZZ	6	12.34
9999V99	6	000000	ZZZZ.99	7	.00
9(5)V9	6	009755	Z(5).9	7	975.5

The $ character

The $ sign can be used in two ways as a fixed insertion character and as a floating character -- just like the Z character. When the $ sign is used as a fixed insertion character, it is placed at the left of an edited picture clause to indicate that you want the dollar sign to appear there. For example, to print the result as $584, you must give an edited picture clause as $999. Since the dollar sign is counted in determining the field size, the field length assigned should be greater than the maximum number of significant digits expected, by at least one digit. The use of the $ sign as a floating character will be explained at a later stage. Table III illustrates the use of the $ sign as an insertion character.

TABLE III

Input Field			Output Field		
Picture of the Item	Item Size	Value Stored	Picture of the Item	Item Size	Value Printed
999	3	116	$999	4	$116
999	3	000	$ZZZ	4	
99V99	4	0500	$ZZ.99	6	$ 5.00
99V99	4	0500	$99.99	6	$05.00

The comma (,) insertion character

The comma character is used in an edited picture clause to show where you want the actual comma to be printed. More than one comma can be used in the picture clause. When all the digits are suppressed, the comma is also suppressed. Table IV illustrates the use of the comma insertion character.

TABLE IV

Input Field			Output Field		
Picture of the Item	Item Size	Value Stored	Picture of the Item	Item Size	Value Printed
9(5)V00	7	0234567	$ZZ,ZZZ.99	10	$2,345.67
9(5)V99	7	0000000	$ZZ,ZZZ.99	10	$ .00
9(8)	8	00000234	$Z,ZZZ,ZZZ	10	$234
9(8)	8	23456789	99,999,999	10	23,456,789

The + and the - characters

The + and - characters can be inserted either in the leading position (left end) or in the trailing position (right end) by showing the position of the symbols in the edited picture clause. These two characters operate as follows:

1. The use of a - symbol results in the printing of the - symbol if the value is negative and no sign at all (a blank) if the value is positive.

2. The use of a + symbol results in the printing of the - symbol if the value is negative and a + symbol if the value is positive.

Table V illustrates the use of the + and the - insertion characters.

TABLE V

Input Field			Output Field		
Picture of the Item	Item Size	Value Stored	Picture of the Item	Item Size	Value Printed
S999	3	234	+999	4	+234
S999	3	234	-999	4	234
S999	3	-234	-999	4	-234
S999	3	-234	+999	4	-234
S999	3	001	+ZZZ	4	+ 1
S999	3	-234	ZZZ+	4	234-

The CR and DB characters

The CR and the DB characters are used in accounting applications. These symbols are placed in the trailing positions (right end) only if the values are negative. Table VI illustrates the use of the CR and the DB editing symbols.

TABLE VI

Input Field			Output Field		
Picture of the Item	Item Size	Value Stored	Picture of the Item	Item Size	Value Printed
S9(5)V99	7	-0234567	$ZZ,ZZZ.99CR	12	$2,345.67CR
S9(5)V99	7	0234567	$ZZ,ZZZ.99CR	12	$2,345.67CR
S9(5)V99	7	-0234567	$ZZ,ZZZ.99DB	12	$2,345.67DB
S9(5)V99	7	0234567	$ZZ,ZZZ.99DB	12	$2,345.67DB

Floating string characters ($, - and +)

The $, the - and the + signs can be used either in the fixed mode described earlier or in the floating mode. In the floating mode, the characters are used in exactly the same manner as the Z character. The Z character in repeated positions, starting at the left end of a picture clause indicates in how many positions the leading zeros are to be suppressed. The Z character however, is not inserted before the first significant digit. The floating $, - and + characters, when used in repeated positions, not only suppress the non-significant zeros, but also get inserted before the first significant digit. Two rules apply to the use of floating string characters:

1. Only one character can be used in floating string mode in a single picture clause. For example, it is improper to give a picture clause -$$$$.99, since you have used both the - and the $ in the floating mode.

2. The character used in the floating mode must be in the leftmost position in the picture clause character string. For example, it is improper to give a picture clause -$$$$999, since you have tried to put a character before the floating $. If you want to use a + or - in the same picture clause with a floating $, use a trailing + or -. Table VII illustrates the functioning of the floating $, the floating + and the floating - characters.

TABLE VII

Input Field			Output Field		
Picture of the Item	Item Size	Value Stored	Picture of the Item	Item Size	Value Printed
9(5)	5	12345	$$$,$$$.99	10	$12,345.00
9(5)	5	00123	$$$,$$9.99	10	$123.00
9(5)	5	00000	$$$,$$9.99	10	$0.00
9(4)V9	5	12345	$$$,$$9.99	10	$1,234.50
V9(5)	5	12345	$$$,$$9.99	10	$0.12
S9(5)	5	00123	-------.99	10	123.00
S9(5)	5	-00001	-------.99	10	-1.00
S9(5)	5	00123	+++++++.99	10	+123.00

The cheque protection character(*)

While printing cheques, it is advisable to print asterisks (*) in the blank space on the left, instead of keeping it vacant, so as to prevent insertion of numbers to enhance the value of the cheque. For example, a cheque for 2345.65 dollars appears in the cheque as $****2345.65. The asterisks are referred to as cheque protection characters. They are placed in numeric edited picture clauses and function exactly like Zs, except that each suppressed character is replaced by a * instead of a blank. For example, if you move a pure number 00002345 to a field whose picture clause is $******.99, then the resulting value that is printed is $****23.45.

Alphanumeric editing (B and 0 insertion characters)

The editing characters Z $. , + - CR DB * can be used only in numeric edited picture clauses. The two characters B and 0 can be used either in numeric field or in alphanumeric edited field. B is called the blank insertion character and 0 is called the zero insertion character. Blank insertion character B is used to cause blanks to be placed at the beginning or at the end or anywhere in the middle of an edited field. The zero insertion character is used to insert zeros in any position in an edited field. Table VIII illustrates the use of B and 0 editing characters

TABLE VIII

Input Field			Output Field		
Picture of the Item	Item Size	Value Stored	Picture of the Item	Item Size	Value Printed
AAA9999	7	JAN1284	AAAB99B99	9	JAN 12 84
99	2	35	$99000	6	$35000
XXX	3	500	X00BXX	6	500 00
A(6)	6	ENDJOB	AAABAAA	7	END JOB

Summary

A picture clause's character string thus gives the following information to the computer:

1. The size of the item.
2. The class of the item, whether N or AB or AN or AE or NE.
3. If the item is numeric
   (a) the location of the decimal point
   (b) if it is to be signed (whether +ve or -ve).
4. The location of the editing characters within the item.

Only elementary data items can have picture clauses. A group item is always considered AN even if its components are of the numeric class. Table IX gives the final summary of what has been said about the picture clauses

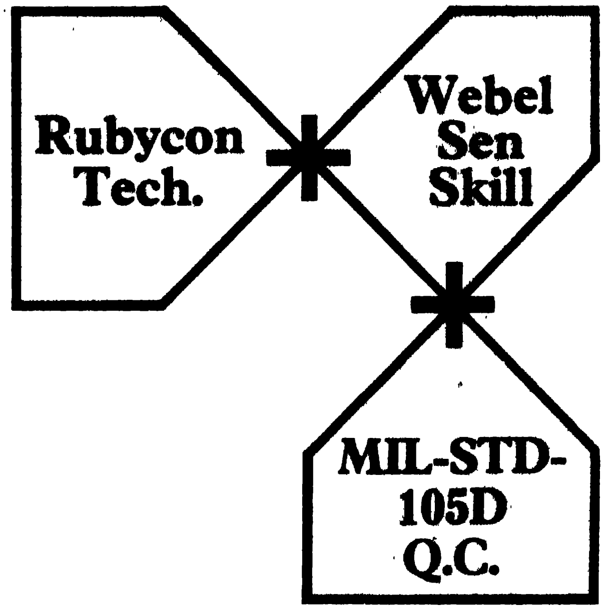
TABLE IX

Class	Data Value May Contain	Picture Clause Characters
Numeric(N)	Only digits	9 V S
Alphabetic(AB)	Only alphabets and spaces	A
Alphanumeric(AN)	Any COBOL character	X 9 A
Numeric Edited(NE)	Digits and any editing characters	$ + - Z CR DB . * B 0
Alphanumeric Edited(AE)	Any COBOL character and the editing characters B and 0	9 A X B 0

The editing features in COBOL are somewhat elaborate and one must gradually get acquainted with them. The study of COBOL rules will take longer than FORTRAN and requires patience from the student.

(To be continued)

The Websen Equation



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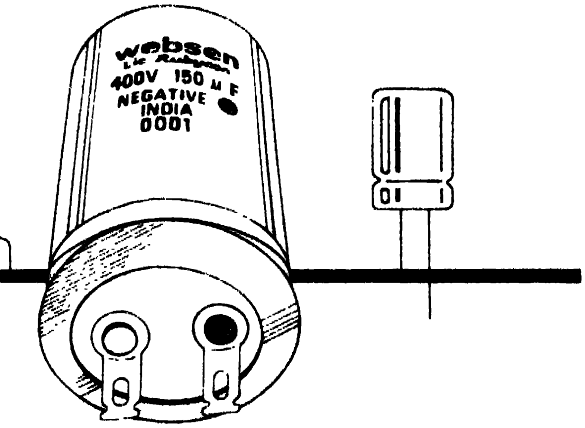

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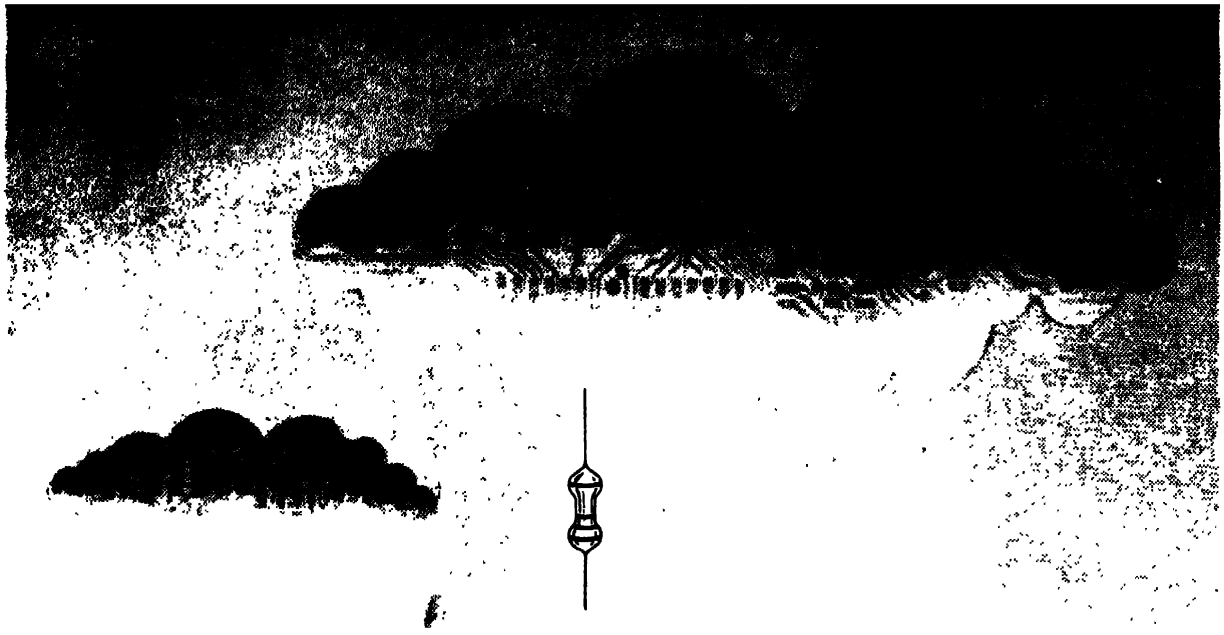

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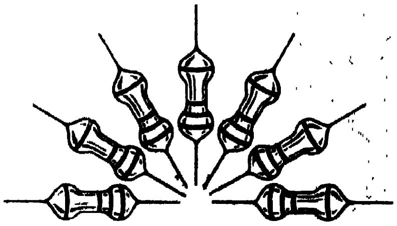

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Characteristics of Fixed Satellite Service

Part I

The fixed satellite service (FSS) is the most heavily utilised of all the space services and probably the most highly developed.

It is therefore necessary to achieve a general improvement in some of the characteristics of FSS networks to minimise the width of the orbital arc and the frequency bands which each satellite network needs for its traffic. Some of these improvements will increase network costs, most particularly, when equipment to more stringent specifications is first introduced.

There must also be improvements in the technical means presently used to manage the geostationary satellite orbit (GSO) by FSS. These improvements are required to allow the arrangement of satellites in orbit, and to optimise their frequency assignment plans. This would enable more satellites to operate simultaneously without unacceptable mutual interference. It would also be desirable since these improved technical management methods require less expert manpower for their implementation than the present methods.

This article provides information on the usage and the users of this service and reviews the main technological factors which characterise today's FSS networks.

The FSS has evolved considerably over the last 20 years and handles a wide range of traffic. The FSS networks currently in operation vary considerably with regard to technical parameters, operational techniques and the services provided. For example, the capacity of the radio carriers may vary from a single telephone channel (SCPC) to several thousand channels; the corresponding bandwidths of the carriers range from about 20 kHz to 70 MHz and modulation may be analogue or digital. The systems are used to provide telephony, television, teleconferencing, data transmissions, intracompany services, communication between computers, telecommunication services for isolated regions and weather forecasting services. The services and characteristics will continue to change in the future with technical progress.

Today's satellite services are implemented in several ways, viz, by independent space networks, by consortia or by lease of space segment from operating organisations. The choice can be related to need or economic viability, although technical characteristics may be similar. Existing systems mainly use the 3700-4200 MHz, 5925-6425 MHz, 10.95-11.20 GHz, 11.45-11.70 GHz, 11.7-12.2 GHz and 14.0-14.5 GHz bands although some use is also made of the 3400-3700 MHz, 5725-5925 MHz, 7250-7750 MHz and 7900-8400 MHz bands and of other bands between 12.2 and 12.75 GHz. A beginning has been made in using certain FSS allocations above 15 GHz.

Some FSS networks use spacecraft with multiservice and/or multifrequency telecommunication payloads. There appears to be a growing trend in the use of such satellites due to the availability of larger spacecraft. This situation may introduce additional constraints to the harmonisation process, especially if the orbital position of the satellite is determined by a previous plan, for example, the broadcasti satellite service (BSS).

Another fundamental characteristic of the FSS is the wid range of service areas. In general, there are three categories of coverage global, regional and national. Initial exploitation of the FSS was largely for trans-oceanic communications and this continues to be a growing and very important use of the geostationary satellite orbit.

International systems provide a wide range of telecommunication services. INTELSAT and INTERSPUTNI are examples of the use of frequency ranges 6/4 GHz a 14/11 GHz. Regional systems in the FSS are operated specific groups of countries to provide joint telecommuni tion services. Current systems use the frequency ranges and 14/11 GHz. The EUTELSAT regional network w

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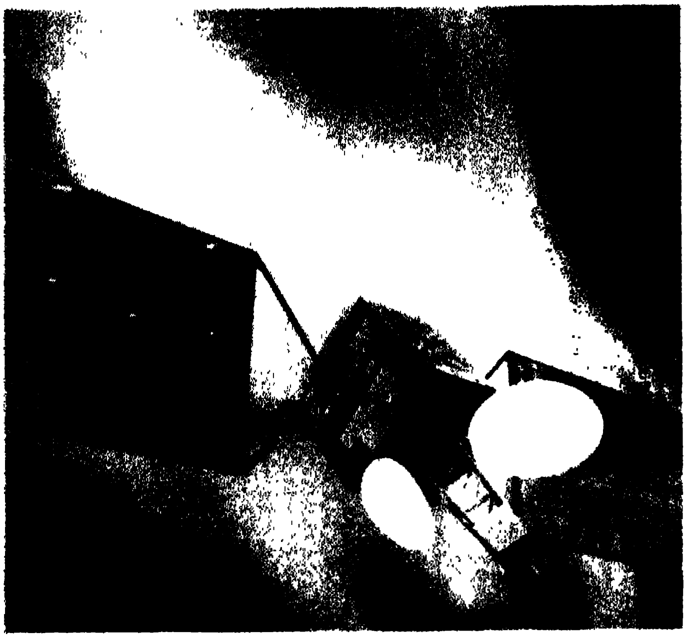
This article is based on the report of the ITU (International Telecommunication Union) reviewing the characteristics of typical in-service networks of FSS.

soon begin operation in the 14/11-12 GHz bands for European international traffic and has already come into service to meet certain domestic and international requirements, with the lease of standby capacity. The ARABSAT regional network is already in operation in the 6/4 GHz bands.

National satellite networks are used by various countries to satisfy their national telecommunication needs. Demands for such networks are increasing in all regions. Such systems mainly use the 6/4, 14/11 and 14/12 GHz frequency ranges. However, there is at least one operational system which utilises the 30/20 GHz FSS band.



Apart from the technical differences, an important difference between international and national networks is that the most suitable orbit locations are usually not the same, thus minimising conflicts in that sense. On the other hand, the technical differences often lead to difficulties in coordination despite the orbit separations that are feasible.

Another major difference between international and national networks relates to the coverage areas. The former can offer wide coverages, while the latter might conform approximately to the boundaries of the country itself. This leads to some technical disparity between the two networks. In the case of domestic systems, where the coverage areas are sufficiently separated, satellites can operate in close proximity.

Feeder links to satellites of various services, such as the mobile satellite service and the broadcasting-satellite service, may be assigned frequencies in bands allocated to the FSS.

The growing number of satellites in service gives rise to increasing difficulties to administrations trying to use orbital positions within segments of that orbit and in preferred frequency bands, that are intensively used by other countries. In fact, there are certain orbital segments and frequency bands that are already congested, and this may lead to coordination processes which may be complex and costly.

FSS networks operating at 6/4 GHz

By far the most highly developed, both in technology and utilisation, the 5925-6425 MHz and 3700-4200 MHz bands are used on nearly all the commercial FSS networks in service as well as those in the planning stage. This has led existing system operators to employ advanced techniques and design (e.g., lower side-lobe antennae, polarisation isolation and shaped beams) to allow larger numbers of satellites to access the orbit in these bands.

Several of the other frequency bands allocated to the FSS in this frequency range are limited in their use by significant inter-service sharing considerations. However, there is substantial bandwidth in the expansion bands at 6 and 4 GHz for which there are no significant sharing problems in many parts of the world. These bands are essentially unused by the FSS today. In addition, because of the proximity to the conventional 6/4 GHz band, the technology from this band could be transferred to the 6/4 GHz expansion band without significant cost to systems operating only in these bands.

Space stations at 6/4 GHz. The earliest FSS space stations were in international service and provided global coverage capabilities. Within ten years, domestic coverage satellites were in service. Regional coverage systems are a more recent development as more countries are beginning to use satellite technology for domestic services or as a supplement to regional terrestrial systems.

Along with the growth in numbers of satellites, the capacity of a single satellite has been increased by frequency reuse accomplished by the use of orthogonal polarisation in the same coverage area and/or spatial isolation between narrow spot beams on the same satellite serving different coverage areas. This is generally a characteristic of international networks; in some such networks six-fold frequency reuse has been obtained in this way. Domestic FSS systems, on the other hand, have utilised orthogonal polarisation to achieve a two-fold frequency use. An example of the usage of fixed-satellite networks operating at 6/4 GHz is illustrated in Fig. 1. Some of these satellites are not in orbit now. Also, not all the satellites are operating in the full band.

Fig. 2 displays the use of the 6/4 GHz band relative to other currently allocated FSS bands. Here, multiple entries appear at some orbit locations which provides for contingency or replacement of one satellite series with another and reduces the number of real operational satellites carrying traffic. The total transmission capacity of these satellites depends on a large number of factors including earth-station antenna size and satellite communications payload parameters.

It is common for present-day FSS space stations to have the capability to maintain station keeping within tolerances of ±0.1° in both latitude and longitude. In some cases the north-south excursion may somewhat exceed this figure without detriment to orbit utilisation. Such tolerances are often met in actual operations, particularly for domestic

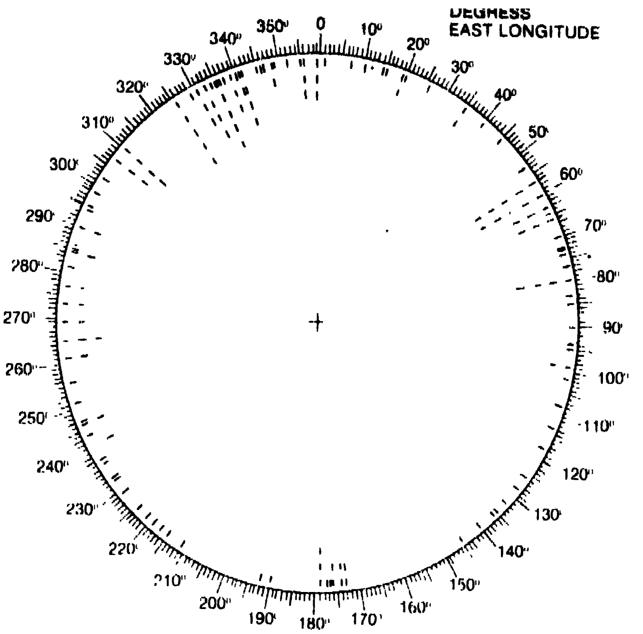


Fig. 1: Orbital locations of 6/4 GHz FSS entries.

networks with large numbers of earth stations, for which steerable antennae are economically unattractive.

Expected satellite lifetimes have increased substantially over the past 20 years, with the design lifetimes of ten years being currently most common. It should be noted, however, that the design lifetime of a space station may not be the same as its operational life at a particular orbit location. This may occur in a particular satellite network, where traffic is rapidly growing, and a higher capacity design is introduced before the design life of the first spacecraft is reached. In such cases the satelite launched earlier may be relocated to satisfy other traffic requirements.

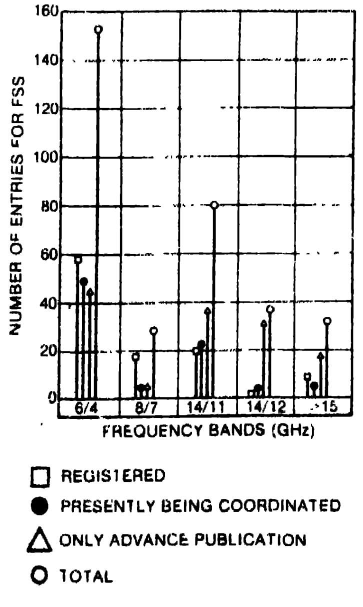


Fig. 2: Tabulation of FSS entries by frequency band.

[illegible] equivalent isotropically radiated power (EIRP) has increased, lower-cost, smaller diameter, earth-station antennae have become operationally feasible. The largest antennae are used primarily in global coverage systems although they may also find applications in domestic networks for high capacity links. Antennae with diameters in the range of 10 to 15 m are common for medium capacity routes or special service applications in global coverage systems. Smaller antennae in the 3 to 7 m range are particularly suited to services in regional and national coverage systems, as well as for receive-only applications.

FSS networks operating at 8/7 GHz

Several FSS networks are presently in operation in the 8/7 GHz bands and a number of new networks are expected to become operational in the near future. Fig. 3 shows networks operating at 7 and 8 GHz. The satellite density is obviously much lower than in the 6 and 4 GHz bands. The space stations already in orbit are represented by dashes within the circle. Many of these systems also operate in the mobile satellite service (MSS). Further, these networks are primarily used for official correspondence within and among a number of administrations.

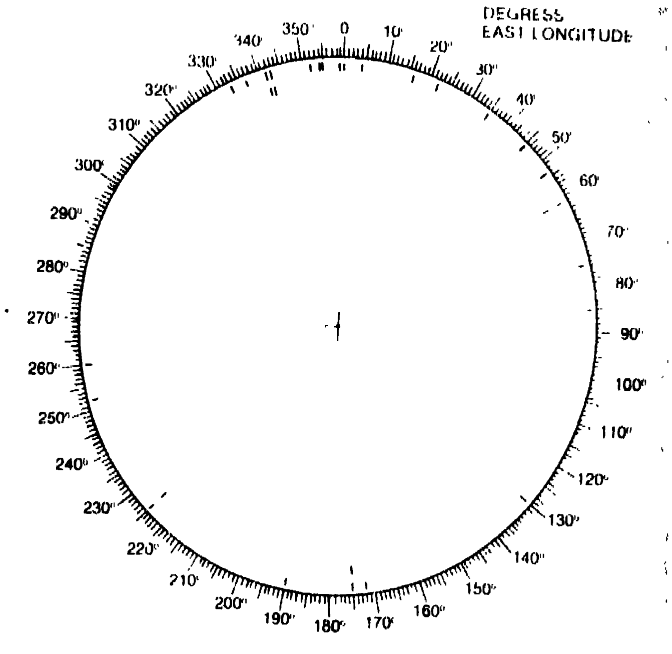


Fig. 3: Orbital locations of 8/7 GHz FSS entries.

Some basic factors which are common to a number of satellite systems using the 8/7 GHz band are: (i) large service areas, i.e., approaching the visible areas in size, (ii) earth coverage, hemispheric coverage and re-directable narrow beam satellite antennae, (iii) capabilities for changing satellite antenna/transponder configurations, (iv) circular polarisations; no frequency reuse within a network, (v) large differences in earth-station antenna sizes, the smallest are in the order of 1 to 3 m, and (vi) relatively high maximum ion gains which coupled with high up-link satellite antenna gains, results in relatively high up-link sensitivity. These factors are consistent with satellite networks which could operate in either or both the FSS and the MSS. Conversely, there is no uniformity in transponder arrangements, frequency translations, satellite antenna configurations, or types of modulation, carriers, and satellite accessing. The meteorological-satellite and earth exploration-satellite services also have frequency allocations with primary status in these frequency bands; these services could have very different characteristics from those of the FSS and MSS.

FSS networks operating at 14/11 and 14/12 GHz

FSS systems in the 14/11-12 GHz bands have become operational only within the last seven years. Over that time, significant improvements in orbit/spectrum efficiency and capacity have resulted from progress in the technologies associated with these systems. In Fig. 4, the various space stations operating at 14/11-12 GHz are indicated by dashes within the circle.

A particular attraction of these bands as compared to the 6/4 GHz bands, is the ability to provide high satellite EIRP permitting the use of smaller earth station antennae for many telecommunication services. This arises partly from the facility with which satellite transmitting antennae of higher gain can be provided and partly from the fact that some of the space-to-earth frequency allocations near 12 GHz are not generally shared with terrestrial services having primary allocation status. A sample analysis of the information on current satellites using these bands indicates that the median value of the gains of satellite beams is about 38 dB, with upper and lower decile values of 49 dB and 29 dB respectively. The availability of improved launch systems and improvements in satellite power technologies have facilitated this development. As a consequence, many new satellite communication services relying upon small aperture earth station antennae are being implemented.

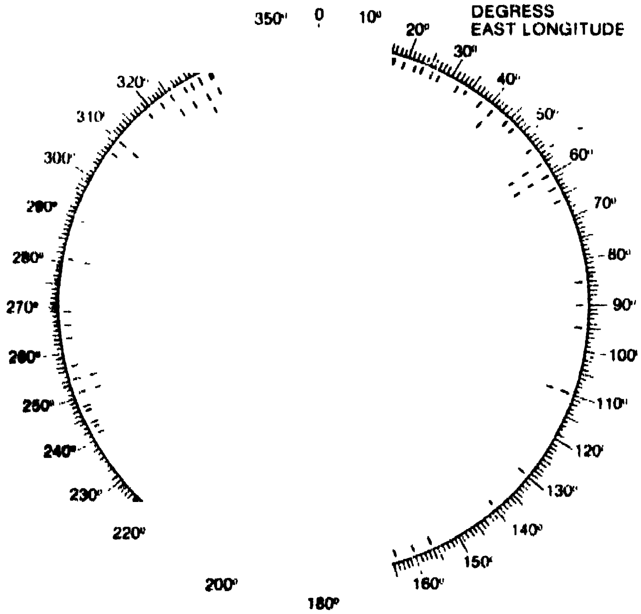


Fig. 4: Orbital locations of 14/11-12 GHz FSS entries.

The principal disadvantage of the use of frequencies above 10 GHz is the higher RF signal attenuation and depolarisation effects in areas subject to heavy rainfall. Various techniques to alleviate these problems are available and include up-link power control and adaptive depolarisation cancellers. At 14/11 GHz and higher frequency bands, the service arc restrictions are severe for networks with very large service areas and those with service areas at high latitudes. This is so because earth stations in these bands normally require operation at higher elevation angles than 6/4 GHz in order to reduce rain attenuation and depolarisation effects to acceptable levels.

Frequencies above 15 GHz

Studies are in progress to define the parameters of space stations operating in the 30/20 GHz band, and two countries have already launched experimental space stations operating in these bands. In general, the use of frequency bands around 20 GHz and 30 GHz, where 3.5 GHz bandwidth is available, would make possible the provision of very high capacity systems using narrow spot beam antennae and high-speed digital transmissions (Fig. 5).

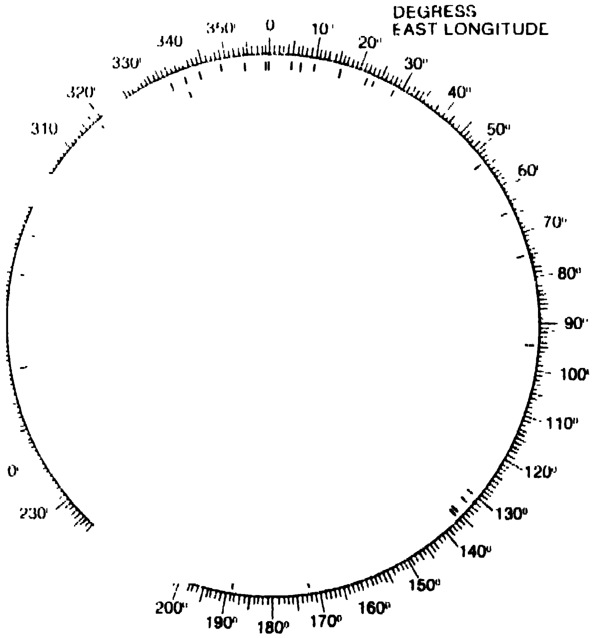


Fig. 5: Orbital locations of > 15 GHz FSS entries.

A diversity of earth stations may be required (in areas of high precipitation rates) in order to ensure that service availability is high. It is also expected that very broadband transponders will be used at these frequencies.

(To be continued)

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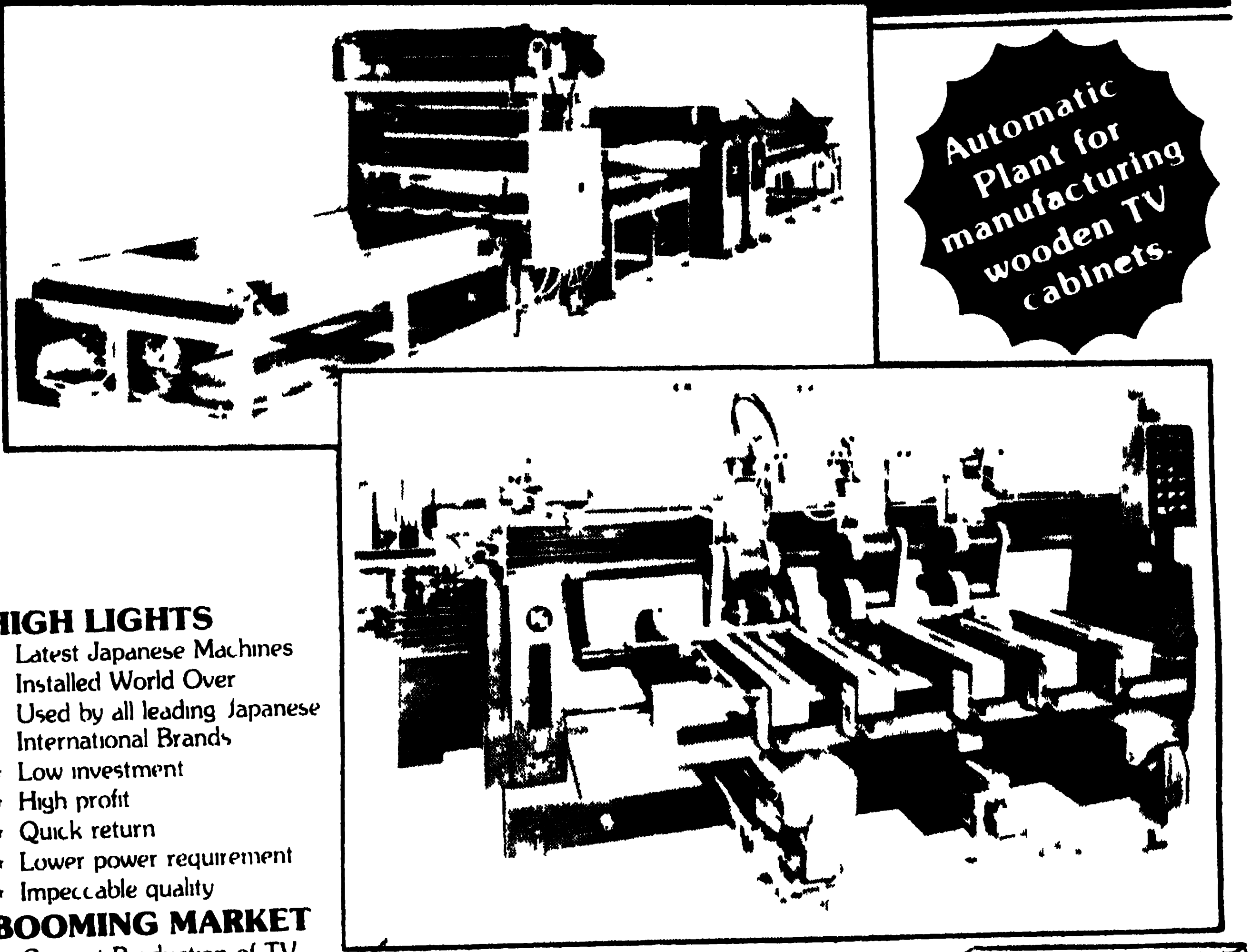

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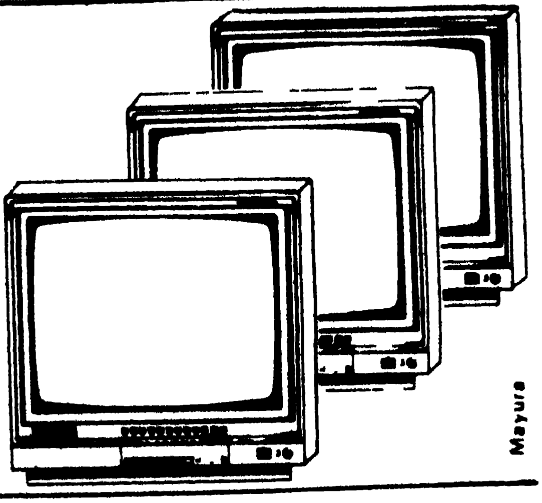

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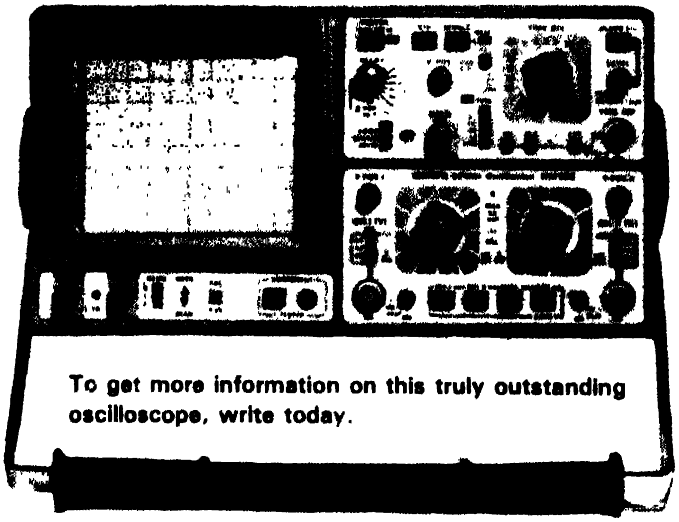
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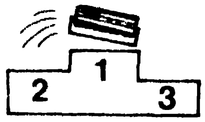

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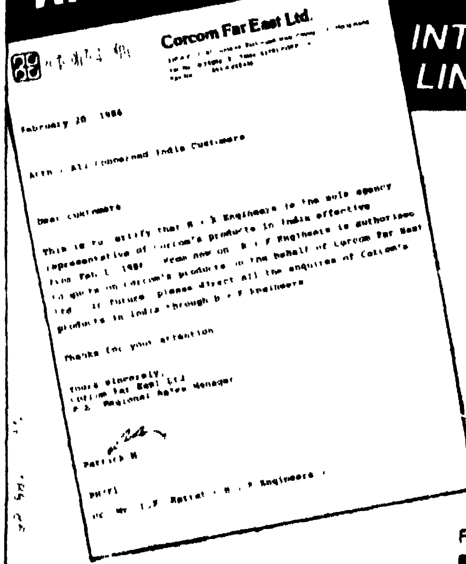
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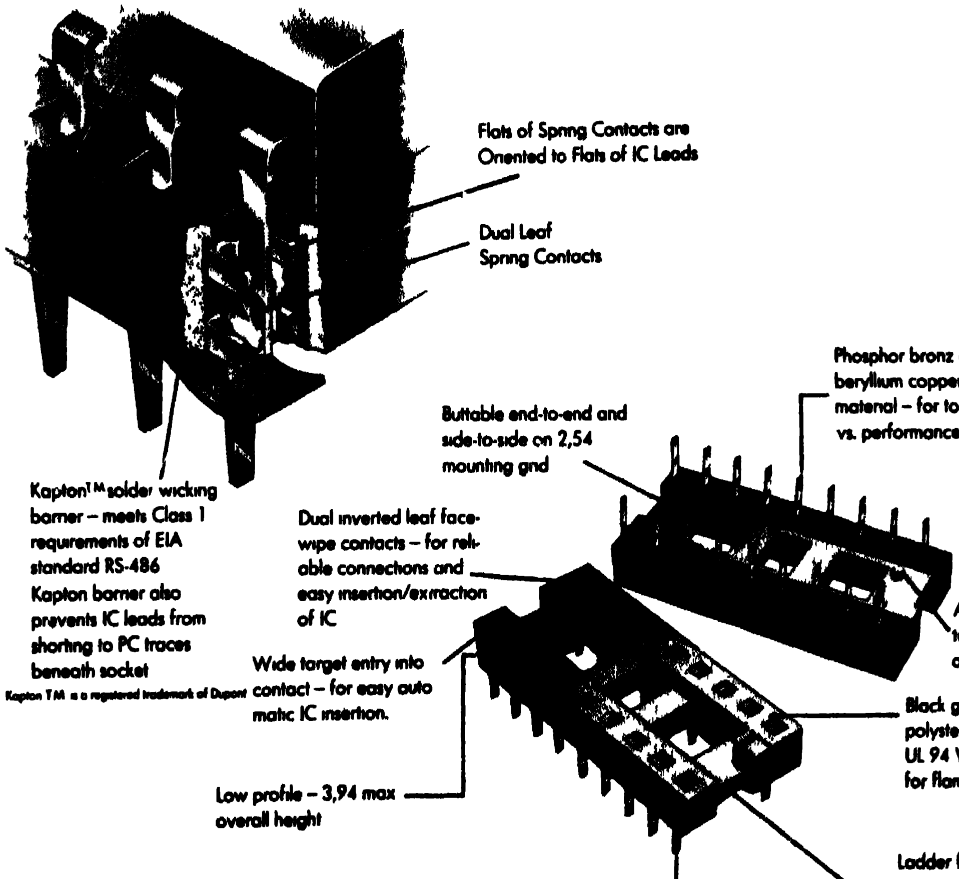
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Behind the Portable Power Sources

Part I

A.V. Jacob

Even before the first electronic device rolled off the production line more than forty years ago, engineers were already searching for ways and means to reduce the weight and volume in every second device designed. Indeed, LSI and VLSI state-of-the-art resulted in an apparent breakthrough in the assembly of consumer electronic gadgets. However, greater the miniaturisation, greater the complexity and chances of failure. A large percentage of supplementary features are discarded in order to squeeze the dream device into your pocket. Ponderous constraints like power output, memory capacity and number of displays—to name a few arise from the limitations of size, weight and hence the strength of the power sources.

The early portable devices were commodious but inconvenient, and often required a line-feed to balance the cost-benefit ratio. Today, the scene of affairs is changing rapidly. One can find digital clocks placed in anything from necklaces to head bands or at the end of ballpoint pens. The modern day grandfather's clock can select one of any twelve melodies played at every quarter of an hour. However, these devices can be disappointing if, without distorting their external dimensions, adequate driving energy is not provided.

Primary cells

The earliest form of portable electrochemical source of power was the primary battery. This cell provides current at a certain voltage and gradually exhausts itself with use or on extended storage. The voltage slowly falls with time until the cell becomes unproductive and must be discarded. Energy density (watt hours or milliwatt hours per unit volume), shelf life (percentage of energy density left in the cell after a specified period) and the rate of salting (build up of salt crystals on the external cell surface) vary with the chemical system adopted for the fabrication of the cell. Normally, primary batteries cannot be recharged from an external source, since it may lead to spillage of chemicals and sometimes even cause explosions.

In the near future, thermal or photon power sources, apparently, will not be able to replace the ubiquitous chemical sources presently used in electronic circuits. The only viable competition may come from solar cells, which have yet to become popular. As an entirely separate venture, there is a growing split in the application areas of the principal energy sources. Electronic devices like wrist watches, hand-held games, hearing aids, cameras, flash lights, toys and pacemakers have fared rather well with chemical sources.

In the recent years, manufacturers have tried to accommodate solar cells by lowering the voltage and power consumption of the electronic devices, but this has resulted in a large-scale production of miniature cells and batteries. There is a spectacular boom in the production of throw-away primary cells. The focus of development is directed mini-power sources along with new packaging and case designs.

The energy stored in a battery is fed into the consuming device, but several factors such as the load current, type of chemicals used, and the size of the device can cause disruptions. The voltage and current fall rapidly at a certain load current. This irratic behaviour results from a tug-of-war between two mechanisms one generating electricity and the other draining it away. The former is a power house of remarkable capabilities if it is continuously replenished. The latter, often called the 'internal resistance' of the battery, however, puts restrictions on the current, voltage etc and acts like an internal load. Though the internal resistance of battery cannot be eliminated totally, its effects can be reduced by combining a number of sources parallel to each other. For higher voltages and effective power release in a battery, a low internal resistance is imperative.

The most widely used and readily available portable power source is the dry cell (a misnomer, since it is wet inside) belonging to the class of primary cells. A primary cell once charged is used until it is discharged completely and then discarded. The dry cell is a special form of the Leclanche cell. The three popular versions of the primary cell are carbon-zinc, zinc chloride, and alkaline manganese dioxide all packaged in standard cylindrical cases designated as D, C, AA, AAA, and N. Rectangular 9V packages with both the terminals on one end are also available (Table I).

The much talked-about polapulse wafer batteries are nothing but the traditional Leclanche carbon-zinc cells designed by Ray-O-Vac mainly to power SX-70 Polaroid Land cameras. The physical dimensions being the only difference (77.2 mm × 87.6 mm × 4.6 mm), each cell appears like ten playing cards stuck together. Further, it weighs only 28 gm. This cell contains a thin conductive card (the duplex sheet) which is coated on one side with manganese dioxide and the other with zinc. This duplex sheet forms one half of each of the two adjacent 1.5-volt cells separated by a gelled electrolyte deposited on synthetic fibers. This conductive layer precludes the need of soldering or welding as in the case of ordinary nium foil coated with manganese dioxide, while the other side of the battery has another aluminium foil coated with zinc acting as the negative terminal. The cell combination is mounted on a card of proper dimensions, with adhesive bonds around its perimeter providing a sturdy structure. A comparative data is presented in Table II. Polapulse is meant only for very short interval applications. In this respect, its utility is uncomparable to any other size/capacity

TABLE I
Standard Cell Housings

Size	Diameter mm	Height mm		Capacity NiCds, mAH
RR	22.6	42.1		1200
SF	41.7	91.3		10,000
AAA	44	11		180
AA	50.2	14.3		500
½ AA	28.1	14.3		250
½ A	28.1	17.3		450
C	49.7	25.9		2200
D	60.5	32.9		4000
F	91.3	32.9		7000
PP3	49(h)	26.5(l)	17.5(b)	110
PP9	81	66	17.52	1200

TABLE II
Comparison of Properties

Load Current Amperes (150 msec)	Potentials Across the Battery of 6-volt Pack		Terminals-Volts
	Zinc-Carbon	Alkaline	Polapulse
0.5	5.5	5.5	6.2
1.0	4.0	5.0	6.1
1.5	3.0	4.5	6.0
2.0	1.5	4.0	6.0
2.5	0.5	3.5	5.9
3.0		3.0	5.8
3.5		2.5	5.6

Mercury batteries have a high energy density and comparatively long shelf life. In comparison with the primary cells, the decline of their voltage level is minimal and they can be discharged either continuously or intermittently without any recovery period. The major shortcoming often cited is their inability to supply short-term high current.

The alkaline cell is highly suitable for continuous heavy duty high-drain conditions. For the same cell size, an alkaline cell can provide twelve times the capacity provided by the carbon-zinc cell. Alkaline cells do not suffer from electrolytic leakage and can also function excellently within a temperature range of -20°C to +70°C. If the power consumption is at extremely low temperatures, the appropriate choice is the silver oxide cell which can operate at temperatures as low as -30°C. Its other characteristics are otherwise similar to that of the mercury cells.

Though in the past, lithium cells played second fiddle to most notable energy sources, it is now fulfilling several present day energy requirements. For the convenience of a highly reliable standby power for CMOS RAM retention, lithium cells may prove to be an undisputable compromise.

All lithium cells are non-aqueous units using reactive alkaline lithium with compounds like iron sulphide, copper oxide or manganese dioxide as the cathode. These cells have characteristics similar to those of the alkaline manganese cells fortified with outstanding shelf life. Manganese dioxide-lithium cells are very popular among consumer and industrial applications ranging from wrist watches to calculators to cameras. Manganese dioxide-lithium cells in wrist watches guarantee five years of continuous operation as opposed to the six-month life of the carbon-zinc version of the same dimensions. Another superior version of solid lithium is the carbon fluoride-lithium cell manufactured by [illegible] which has an output of [illegible] volts as opposed to 1.5 volts of the iron sulphide-lithium version.

Liquid cathode lithium cells use electrolytes like thionyl chloride, sulphuryl chloride or sulphur dioxide. Of these two, thionyl chloride has the maximum energy density and gives 3.5 volts output. In terms of capacity, these cells are similar to manganese dioxide or carbon fluoride cells. Conventional C and D sizes of thionyl chloride liquid lithium cells are manufactured by Saft and Taridan, Israel. The sulphur dioxide version of the 2.9V lithium cell is available from Duracell. The main area of consumption for liquid lithium cells is as semiconductor memory back-ups, aircraft rescue beacons, telemetric instruments, transceivers and in a variety of consumer, industrial, medical, scientific and military applications.

TABLE III
Energy Density of Cells

Type	Terminal PD volts	Capacity Range mAH min.	max.	Energy density W hr/Kg
Zinc-Carbon	1.5	40	20,000	66
Alkaline Manganese	1.5	40	20,000	97
Mercury-Zinc	1.35	35	28,000	98
Silver Oxide	1.5	50	750	130
Mercury-Cadmium	0.9	40	800	22
Zinc-Air	1.4	100	1000	220
Sea Water	1.9	200	2500	200
Lithium MnO2	2.8	190	1000	180
Nickel-Cd	1.34	750	7000	26
Lead-Acid	2.0	750	8000	24

Some of the sulphur dioxide-lithium batteries have shown catastrophic failure within two or three years of operation. Researchers at the Saudia National Labs, USA found the cause to be the corrosion of the high quality silicon glass used to isolate the anode of the cell from the cathode. This problem was overcome by the introduction of a new, highly corrosion-resistant insulator called TA-23 glass which has significantly more alumina in its composition and contains about 20 per cent less silica than the conventional glass electrical insulators. According to the Saudia engineers, TA-23 glass helps reduce corrosion by at least a factor of 1000 as compared to the ordinary glass insulators. Further modifications may even increase this corrosion resistance factor to 10,000, guaranteeing the life of sulphur dioxide-lithium cells beyond five years. The Ferro Corporation, USA has undertaken the task of large-scale production of TA-23 glass, a progress towards the era of reliable high-stability batteries.

The zinc-air cells have received enormous stimulus today from acute requirements of highly inactive power sources while they are dormant or in no-load state. Zinc-air cells use oxygen as the positive electrode, while zinc acts as the negative electrode, the electrolyte being potassium hydroxide. The cell is activated by removing the tape seal stuck over an extremely narrow air hole which admits oxygen into the cell. Vac are the pioneers in this field. Due to its simplicity in use and excellent shelf life, zinc-air button cells are preferred in hearing aids, made to customers' order and requirements.

Sea-water activated cells are an alternative to zinc-air, but are meant only for emergency use at sea with survival kits, location beacons, rescue buoys and May-Day callers. Based on either magnesium-silver chloride or magnesium-cuprous chloride, these cells activate within a few seconds of the electrodes coming in contact with the sea water. The cell has a shelf life well above six years and, under favourable conditions, its output voltage approximates to 1.9 volts. This is a special-purpose battery supplied according to the customers' orders. The major drawback is this cell's unreliability at temperatures close to zero and it may not get excited at sub-zero levels at all.

Secondary cells

The discharge-charge reactions for secondary cells are chemically reversible, i.e. after discharge they can be recharged by applying an external DC source and the discharge-charge cycle repeated. Also they can be recharged any number of times, restoring them to full operational voltage. They are commonly used in high current applications.

Lead-acid cells are available in a wide range of shapes and considered to be the best among the general-purpose batteries. Nickel-cadmium, or nickel-iron is the second among the secondary cells. A good many of these cells are interchangeable with the standard sizes of primary cells and are believed to be advantageous if the recharging facilities are readily available. Another alternative is the expensive silver-zinc batteries with outstanding high energy storage per unit volume and weight. These are used in instruments where low weight and high output are of supreme importance.

The positive electrode of the NiCds is formed by nickel hydroxide which bridges the negative electrode of metallic cadmium through the electrolyte potassium hydroxide. These cells are hermetically sealed. The voltage output is only 1.2 volts per cell as against 1.5 volts from carbon-zinc dry cell. A number of manufacturers produce cells of different capacities for a given size, ranging from 150 mAh to 7 Ah at a 5-hr rate. Though nickel-cadmium cells may cost four to five times the price of dry batteries, their rechargeability offers a potential saving in the long run. Application areas are calculators, portable tools, toys, computer memories, transceivers, aircraft ignition systems and other transistorised systems.

Lead-acid and NiCd cells both have their advantages and disadvantages. Lead-acid cells are bulkier but their charging conditions are not as stringent as that of NiCds since the latter must be discharged completely before charging in order to achieve maximum capacity. Besides, NiCds' charging characteristics are dependent on the case ambient temperature and the internal pressure. If the process of recharging is not carefully controlled, there is also a strong possibility of an explosion. Table IV shows that for quick charging, the initial rise in temperature is very rapid with a nominal change in internal pressure. A further increase in the internal temperature with respect to the percentage charge is sluggish but offers a drastic change in its internal pressure. In an overcharged state, the internal pressure shoots up along with the drop in the cell voltage. Any further attempt to overcharge may culminate in an explosion. However, all cells may not explode due to variations in the tensile strength of the case or container.

TABLE IV
Typical NiCd Fast Charging Pattern

Cell Charge per cent	Terminal PD volts	Rise in Temperature °C	Rise in Pressure per cent
25	1.43	30	10
40	1.44	32	12
50	1.44	34	15
60	1.45	36	17
70	1.45	38	18
80	1.46	40	20
90	1.47	42	35
100	1.48	45	40
110	1.49	47	60
120	1.48	47	100

Note: Ambient/initial cell temperature 28°C; initial pressure 76cm of mercury.

Cell sizes and potential

The size of the cell is more decisive in its ability to deliver the current into the load, but this cannot be completely expressed in terms of the capacity of the cell. Though its voltage may be equal to that of a cell of the same family, the current capacity of a cell depends on its size. The selection of a battery size for an instrument depends on its current requirement, frequency and duration of usage. For AAA cells, a 30mA current may prove to be quite heavy, while it is apparently light for D cells. This general statement is valid only if the time for which the load receives the current from the cell is convincingly long, say, a few minutes. If the duration is only a few milliseconds and the passivity after the 'on' state is of the order of a few-hours, the same AAA cells can withstand 30mA of current without an abrupt change in voltage. The majority of cells, especially the carbon-zinc have the ability to rejuvenate, showing an appreciable increase in its terminal voltage level. Intermittent operations at low current levels show a remarkable extension of the usable life span.

Measuring the cell potential is another erroneous area. The cell potential differs substantially under load conditions due to the presence of its own internal resistance. If the internal resistance of the voltmeter is extremely high, the current through it is negligible and the measured voltage under these conditions closes on to the emf of the cell. The reduction in the cell voltage is due to the source resistance or the internal resistance of the cell. For an ideal cell, this internal resistance is zero. However, in practical cases, low internal resistance of the source improves its capacity. The voltage drop across the internal source resistance increases with the increase in load current. Hence, the cell potential is best indicated only at the given load. To avoid false level indications, the terminal voltage of the cell is measured with a dummy load across it. The dummy load can be determined by the simple rule V/I, where V is the no-load voltage and I the load current. This method is reliable only up to a meter rating of 100k per volt, below which the meter resistance at the given range has to be considered as a parallel combination of dummy resistance.

In general, larger cells have better shelf life. For example, the 9-volt PP3 battery has a better shelf life than that of AAA cells. The use of leak-resistant double jackets and storage at low temperatures, preferably at sub-zero levels considerably extends the shelf life of the batteries. High body-ambient temperature and humidity are inversely related to the shelf life. To ensure the maximum benefit, miniature button cells are often sealed in partially evacuated plastic capsules. Once it is removed from this capsule, a gradual and continuous decay sets in. In this regard, both mercury and lithium cells show excellent storage characteristics.

The accumulation of hydrogen on the electrode during discharge is called polarisation. The purpose of special cathode materials is to overcome this effect and are thus often known as depolarisers. Polarisation results as a change in the electrode potential, electrolyte composition and blocking of electrodes by resultant products. These effects are separately identified as polarisation by concentration and mass transport action. The lack of instantaneous depolarisation tends to decline the theoretical properties of the cell. Since the effect of polarisation is unavoidable, no cell can provide a theoretical output voltage and current while it is in use.

Packages of button cells are invariably cylinderical but their dimensions vary immensely. The most common specification is 8mm diameter and 3mm height (often coded by the number 392 and 192). Other versions are 7.5mm(d)×5mm(h) (often coded as 193), 11.6mm(d)×2mm(h), 11.6mm(d)×3mm(h) and 16mm(d)×11.6mm(h). Button cell blocks of 9V, 90 mAhr are also available.

A common size standard and nomenclature has not yet been adopted in the area of primary or secondary cells as in the case of electronic components. However, PX and MN numbers have become common codes for mercury and alkaline batteries. Solar cells often adopt the semiconductor terms like BPX. Sizes also vary drastically but a common directive is bound to emerge soon.

Unlike electronic devices and components, brand image of cell manufacturers has not yet reached its full potential. However, cells and batteries made in India are rarely found in the market even though they are manufactured in collaboration with prominent and experienced foreign companies. Japanese manufacturers like Hitachi, Toshiba, Sakura, Yuasa, Sanyo and Mastsushita are popular probably due to the overflow of their electronic goods which carry these batteries. Other manufacturers are Duracell, Philips, Ray-O-Vac, Union Carbide, Varta (Germany), General Electric, Gould, Elpower, Globe Union, Honeywell, Saft & Tadiram (Telaviv, Israel), Stotron (UK) etc. The only prominent Indian manufacturer is the Tamil Nadu Alkaline Batteries Ltd (TABC) which manufactures batteries in collaboration with Yardney Electric Corporation, USA.

Recharging power sources

A good rechargeable power source is marked by its outstanding float and cyclical characteristics in addition to the superior storage life. Much more has been said about NiCds than about any other rechargeable version of batteries. A chain of electronic circuitry has been developed to support the ailing NiCds, yet under normal use their life is limited to around 500 to 1000 recharge cycles which can spread over two to three years. For this, the cells have to be discharged fully at least twice a month and then recharged accordingly. Repeated instances of excessive battery discharging and delayed passive state before the next recharge may permanently damage the battery pack. And even so, a chargeless dead time of three months after the battery is fully discharged (which is very common in normal use), will spell the end of its life. Even the best variety of NiCds can rarely withstand a few repetitions of chargeless dead time of 24 hours.

Four basic approaches to all recharging processes are widely used today: (i) trickle charging, (ii) normal charging, (iii) fast charging, and (iv) ultrafast charging. The first two are time consuming processes but relatively simple and safe. However, the uncertainty always remains as to how well the cell has been charged and how many usable hours will result from it. In the case of fast and ultrafast charging, it is wise to check the procedure and its reliability against the manufacturers' directives.

The ampere-hour capacity of a cell determines the charging rate of the cell packs. A charging rate of 0.1 for AA pack will be around 50 mA which is the product of its ampere-hour capacity and the charging rate. Similarly, a charging rate of 0.5 for a PP9 packs falls around 600 mA from a constant current source. Charging rates are usually denoted by 0.1C or 0.5C etc.

Trickle charging techniques are employed where the self discharge of the pack is to be compensated. This is almost inevitable in standby packs as in the case of memory circuits, where they come into action for only a very short duration when the leading supply fails. Primary as well as secondary sources are subjected to the trickle charging process. Trickle charging is relatively more effective in dry cells and alkaline sources. On an average, the charging rate is around 0.01C and may increase momentarily to 0.02C-0.05C when the pack returns to its standby mode. No appreciable change in temperature of the cell is expected during this process.

The safe normal charging rate is considered to be around 0.1C. In the case of NiCds, the duration of charging extends from 10 to 14 hours. A considerable change in cell temperature is expected but it will usually be only lukewarm. These power sources are meant to discharge soon after the charging process. In contrast to this, the devices which profit from the quick charging process are the heavy duty versions, which warrant the back-up services of the cell sources very frequently. The sole purpose of this sort of hasty charging is to increase the redundancy and reliability of the leading unit. For NiCds, the charging hours can be reduced to 1-3 hours by a fast rate of 0.3C to 1C, but the cells might become hot. After the fast charging, the cells can be reused within hours. This cooling period is the major drawback of the fast charging technique.

There are several reasons to avoid the ultra-fast charging method. A majority of the presently available cells do not permit this process in regard to their shelf life and discharge characteristics. The ultra-fast charge rate is around 20C within a repetitive pace of few minutes until the system accepts full charge. The individual cell life in the battery pack is difficult to predict, but on an average it is much less than the life span offered by the cells charged by other methods. If all the cells in a battery pack do not have approximately identical characteristics, fast charging becomes increasingly difficult, eventually becoming highly resistant to any further charging attempts. Ultra-fast chargers are normally equipped with the facility for discharging the cells fully before the onset of charging cycles.

Nickel-cadmium cells are recharged periodically or trickle charged continuously, thus being more cost effective than primary batteries which cannot be recharged. On the other hand, rechargeable batteries can only be justified if their portability is fully exploited. If the device is only used indoors or at a place where the power supply is more economical, it is better to use the mains supply leaving the cells as a standby mode. Hearing aids and some of the biomedical remote controls have a peculiar pattern for power consumption filled with intermittent lay-offs. Rechargeable cells are extremely beneficial in these cases where the charging pattern of the cells can be very well maintained.

A good charger should be equipped with charge indicators and, if possible, a monitor for the polarity of the cell.

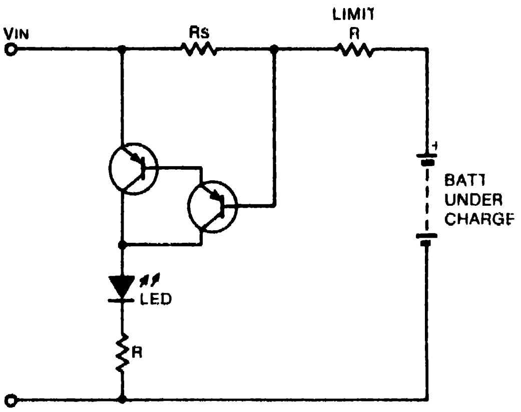

Fig. 1: Battery charge indicator.

The circuit in Fig. 1 gives a good charging indication which can be connected with any charging device, provided the current determining elements are precise and calculated. The base-emitter drop of the transistor is provided by the sensing resistor Rs which can be calculated by the simple relationship

Rs = 1200/I

where I is the charge current in milliampers. When the cells are subjected to a charge, current flows through the sensing resistor causing a voltage drop across it and turning on the darlington combination. Thus, the LED indication will appear only when the cells on charge draw some current.

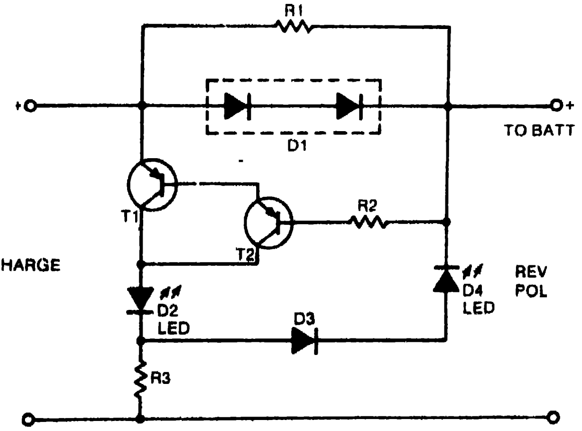

Fig. 2: Battery charge and polarity indicator.

A minor modification for charge indicator will help detect wrong polarities of the cells under charge (Fig. 2). Here, diode D1 provides the base-emitter drive to the transistor. The resistor across D1 bypasses sufficient current into the cells under charge. As long as the cells are charging, the darlington pair will get sufficient drive, turning on LED D2. The presence of D2 indirectly provides a means for the charge regulation. D2 lights as soon as the current flows through diode D1 or resistor R1. Diode D3 and LED D4 take care of the polarity reversal problems. Under the reversed polarity conditions, diode D3 will be forward biased, turning on LED D4.

Variable three-terminal regulators like LM317 peg the output voltage within very close limits over a wide range of input voltage variations and output load variations. This also eliminates the need to stock several voltages. Basically, these can be considered as a combination of a high-gain error amplifier and a pass transistor. The error amplifier monitors the output of the emitter-follower and adjusts the drive to the power transistor keeping the output voltage within tight limits. The whole system is so adjusted that it maintains a constant current through R2 with an output voltage specified by the equation

$$1.25\left(1+\frac{R2}{R1}\right)$$

This current source can be made use of as a charger, especially for NiCds, which unlike lead-acid batteries have to be charged at a constant current. The charging rate can be fully controlled by inserting a series resistor Rs as given in Fig. 3. Then, the source impedance is set by the equation

$$Rs\left(1+\frac{R2}{R1}\right)$$

An interesting modification is possible by introducing a limiting circuit at the adjust terminal of the regulator. The maximum current that can pass through the cells to be charged is dictated by the sense resistor Rs (Fig. 4). Under these conditions, the adjust transistor remains active due to

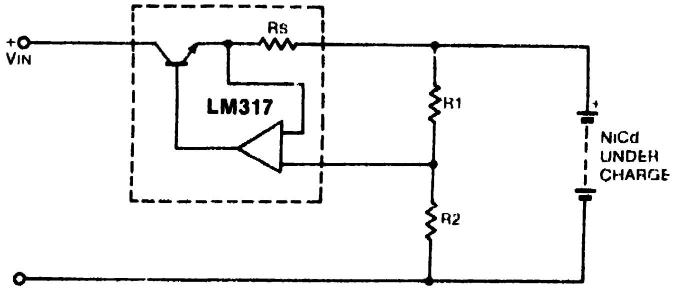

Fig. 3: Variable power source for battery charging.

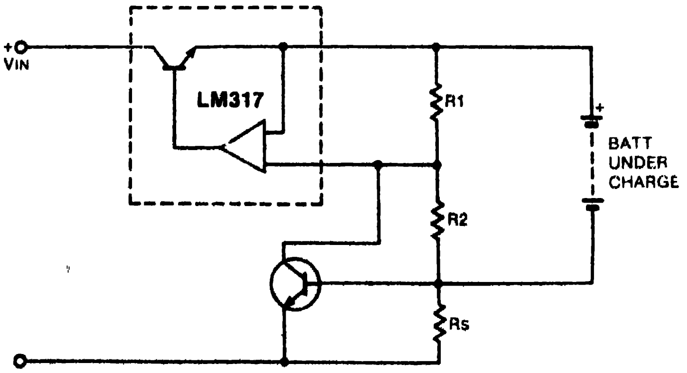

Fig. 4: Battery charger with limiter.

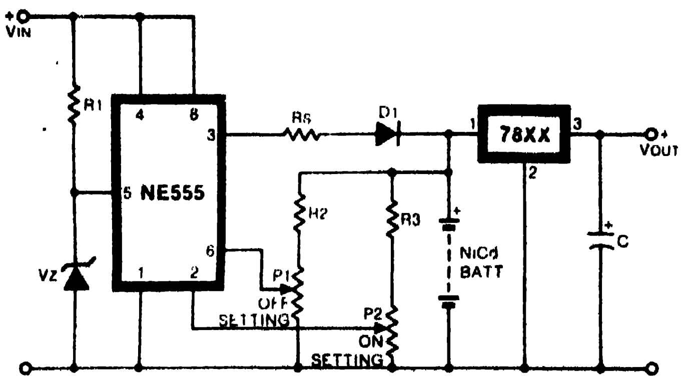

Fig. 5: NiCd standby: mode I.

the base-emitter drive and the charge rate is gradually decreased according to the voltage level developed by the cells.

555 timers are equally popular in battery charging and monitoring circuits. The circuit in Fig. 5 keeps up the full charge in a standby battery supply for any instrument that requires an uninterrupted power supply, but normally draws power from a step-down mains supply. The timer uses a reference voltage by means of a zener diode. The threshold and trigger terminals are used to monitor the maximum and the minimum voltage of the cells under standby mode. In the case of NiCds, the maximum voltage can be 1.4 volts per cell and minimum 1.2 volts per cell. The timer turns on as soon as the trigger terminal senses the preset minimum voltage.

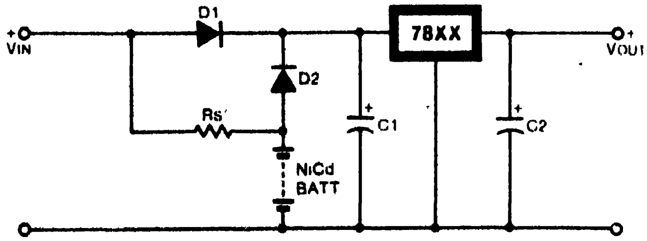

Fig. 6: NiCd standby: mode II.

While it is on, the timer supplies a constant current into the standby battery, the magnitude of which is governed by the series resistor Rs. The output is then regulated by a three-terminal fixed voltage regulator. This supply is almost uninterrupted if there is a short-time power failure.

A majority of the recent versions of the VCRs and video cameras are made to run on rechargeable 12-volt NiCds or alkaline cells. The current consumption is kept to a minimum and a trade-off is adopted between battery size, weight and the video recording time. For example, the VCR of type JVC HR2200 employs a NiCd battery mainly to reduce the weight, sacrificing a number of possible extra functions and features. The set up in this VCR can be approximated as in Fig. 7. To charge the battery, switch S1 is pressed to energise the relay. The two sets of relay contact switches SR1 and SR2 become active, connecting the charge supply through D2 in series with the resistor-thermistor combination and the relay drive is achieved through D3. The resistor-thermistor combination tends to behave like a constant current supply to the charging cells.

The charging rate is fairly faster than normal, hence the cell temperature rises rapidly. At a specified temperature, the thermal switch which is at close proximity to the body of the charging cells opens up, thus stopping the relay from continuing in its active state. Apart from this auto-stopping facility, the normally-closed switch S2 can be opened to return to its main supply mode. Here, the cells are in touch with the charging unit but very little charging takes place due to the voltage drop across diodes D1 and D2. This trickle charging technique keeps the minor losses of the charged cells at a minimum.

A completely self-contained portable oscilloscope is a dream device for electronic enthusiasts. 'Tektronix-221' portable oscilloscope weighs only 2.9 kg and measures 7.5cm × 23cm × 13cm with a display that measures 6.4cm diagonally.

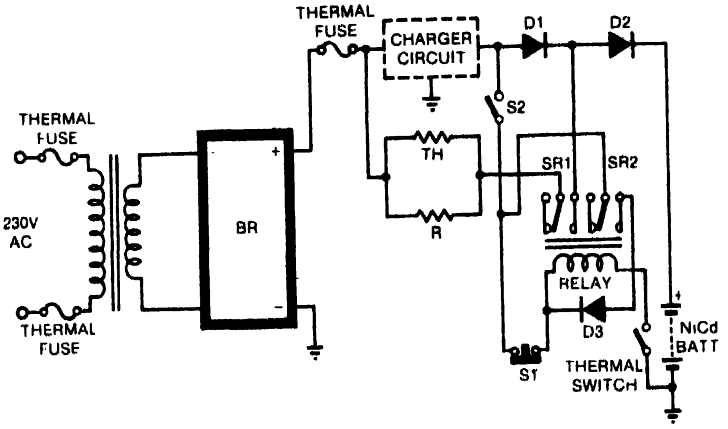

Fig. 7: Typical VCR charger supply.

This is powered from ten A-size NiCd batteries and with full charge it can run for two to three hours. If the mains supply is available, it can run on mains simultaneously charging the NiCds.

A battery indicator on the oscilloscope shows full, low and recharge conditions. When showing recharge, it indicates that the battery charge has dropped to less than 10 volts and a battery discharge protection circuit has interrupted the operation of the oscilloscope to prevent excessive discharge. When the indicator reads low, there are less than ten minutes of operating time left in the system. Obviously, the discharge rate of the battery is a direct function of the trace intensity. In spite of all these restrictions, the controls on the oscilloscope do not differ too much from a standard oscilloscope. The maximum safe input voltage is 600 volts peak-to-peak AC or 600 volts positive DC. The timing of the internal sweep generator spreads from 200ms to 1 μs per division. 'Tektronix-221' oscilloscope can operate over a large line voltage range with an AC range from 90 to 250 volts at a frequency of 48 to 62Hz and a DC operating range from 80 to 250 volts.

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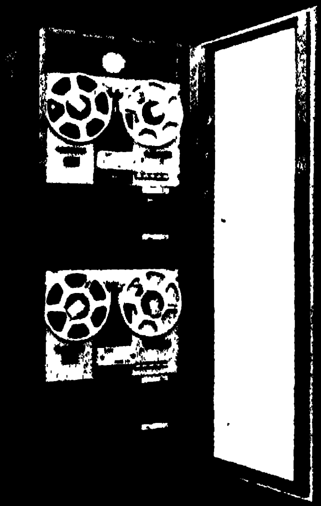

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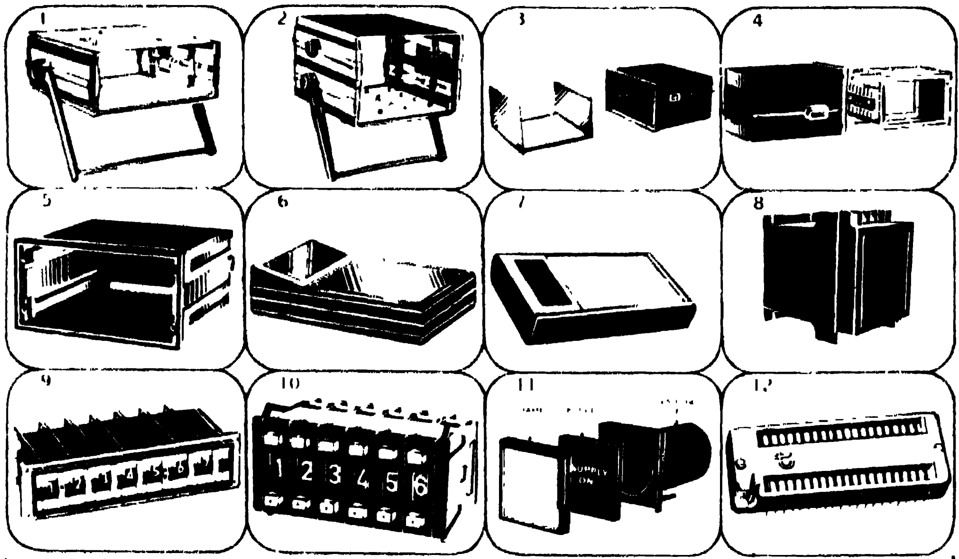

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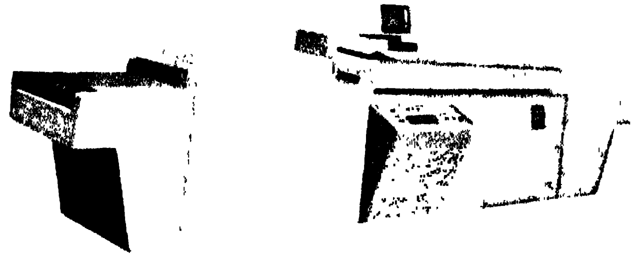

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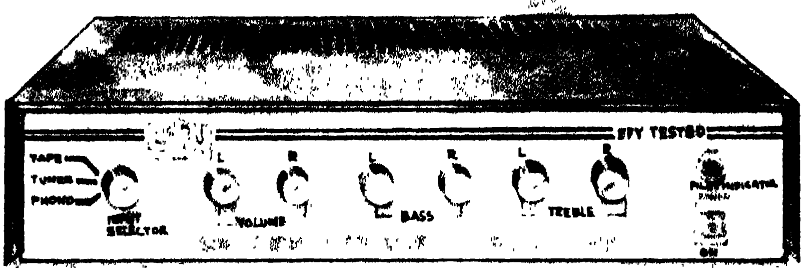


A 120W stereo power amplifier is not so loud when the area which the amplifier must 'cover' is large, though its rating leads one to imagine the contrary. This amplifier is particularly suited to those who conduct music concerts. It is also suitable for use in auditoria. But if you already have something like a 70W + 70W amplifier, there isn't any meaning in making this amplifier. After all, there is hardly any difference between a 70W amplifier and a 120W amplifier as regards power; less than 3dB difference is barely audible. But then, it all depends on where you use it and how you use it.

This amplifier delivers an output of 120W RMS into a 4-ohm speaker. Those who wish to connect more than one speaker can do so by connecting two 8-ohm, 60W speakers or four 16-ohm, 30W speakers in parallel.

The circuit

Transistors T1 and T2 form a differential pair and T9 forms their constant current source. The input stage is not a purely differential stage as can be seen. Transistors T3 and T4, along with T1 and T2, form a sort of cascode-differential pair. The currents at the collectors of T3 and T4 are always constant, except when the signal is present. The cascode arrangement makes it possible to use low voltage transistors at the input. This is very necessary since high voltage transistors are often short of gain. Transistor T5 acts as an emitter-follower for the collector load of T3. This transistor operates at a collector-to-emitter voltage of 5V. T6 is the class-A driver and T8 provides the constant current source. T7 acts as the V_{BE} multiplier and also compensates for temperature changes. The output stage is made of three transistors on each side. Diodes D5 and D6 help to maintain the symmetry.

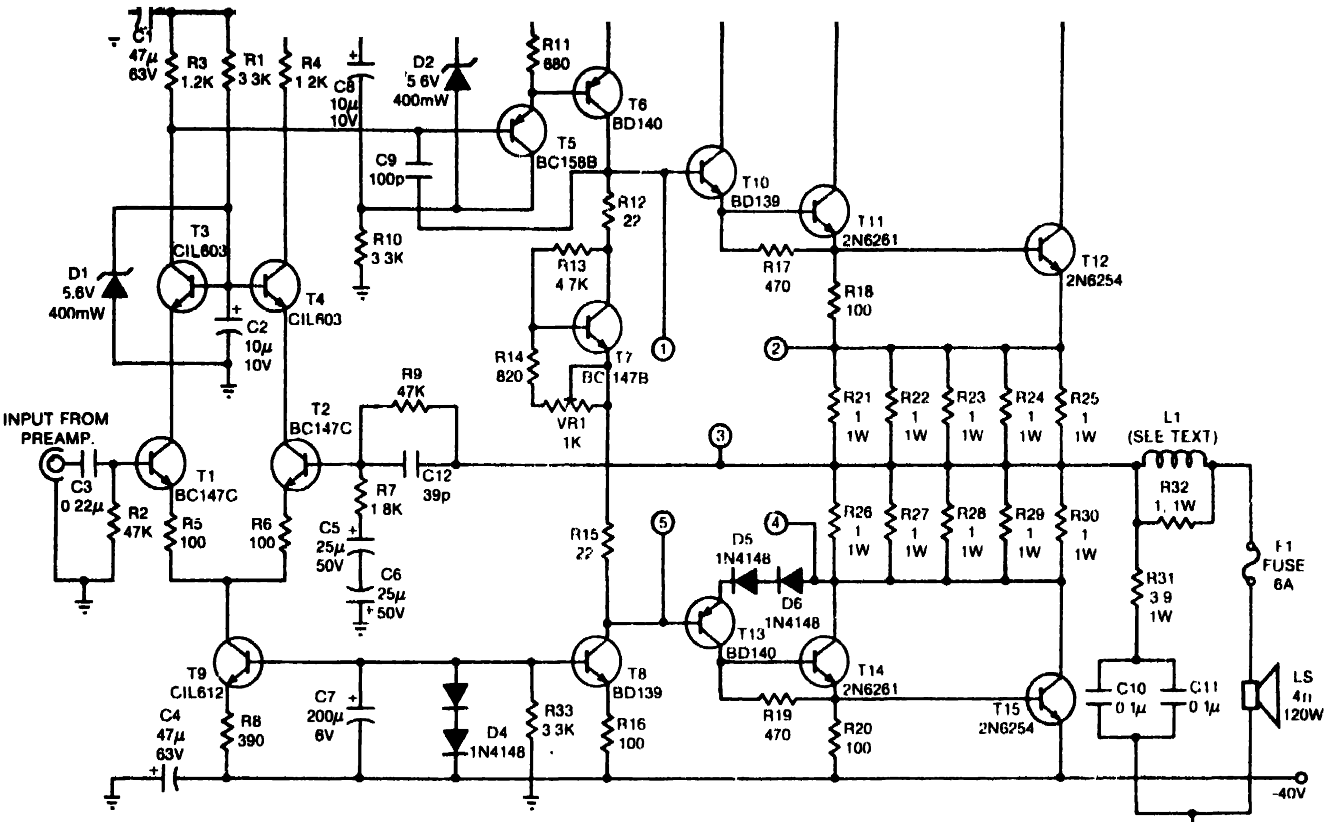
R31, C10 and C11 form the usual zobel network, to suppress spurious oscillations at the output.

The 1-ohm, 1-watt resistor (R32) and inductor L1 at the output are necessary only if any capacitive loads are likely to be used. The fuse protects the speaker from any damage due to DC appearing at the output in the event of a failure in the circuit.

The protection circuit, given in Fig. 5, is not compulsory and can be done away with, if you don't need it. Even when the output goes to Vcc—the saturation voltage of T12 (or Vcc, i.e. the saturation voltage of T15), the power dissipation in the output transistor amounts to a mere 40W at the maximum. The output transistors can withstand 150W (max.). The maximum power dissipation in the transistors occurs when the output is halfway between 0V and Vcc (or -Vcc). In this case, it occurs at 20V, or at 100W. The

SPECIFICATIONS CHART

Output power (THD)=0.1 per cent)	:	120W into 4-ohms load
Input sensitivity (for 120 W)	:	820 mV to 1V
Signal-to-noise ratio (at Po=100W)	:	≥70 dB
Current consumption (DC)	:	1.5A/channel
Distortion at 200 mW output	:	≤0.1%



(ONLY ONE CHANNEL SHOWN, OTHER CHANNEL IS IDENTICAL)
NOTE. POINTS 1 TO 5 GO TO SHORT CIRCUIT PROTECTION NETWORK

Fig. 1: Circuit diagram for 120W + 120W stereo amplifier.

PARTS LIST

Semiconductors:	
T1, T2	— BC147C npn AF transistor
T3, T4	— CIL603 npn AF transistor
T5	— BC158B pnp AF transistor
T6, T13	— BD140 pnp low-power transistor
T7, T16	BC147B npn AF transistor
T8, T10	— BD139 npn low-power transistor
T9	— CIL612 npn transistor
T11, T14	— 2N6261 npn driver transistor
T12, T15	— 2N6254 npn power transistor
T17	— BC157 pnp transistor
D1, D2	— 5.6V, 400mW zener diode
D3-D6	— 1N4148 silicon switching diode
D7-D10	— 2SM15, 15-amp rectifier diode
Resistors (all ¼ watt, ±5% carbon, unless stated otherwise):	
R1, R10, R33	— 3.3-kilohm, ½ watt carbon
R2, R9	— 47-kilohm
R3, R4	— 1.2-kilohm
R5, R6, R16, R18, R20	— 100-ohm
R7	— 1.8-kilohm
R11	680-ohm
R8	— 390-ohm
R12, R15	— 22-ohm
R13	— 4.7-kilohm
R14	820-ohm
R17, R19	470-ohm
R21-R30, R32	1-ohm, 1W carbon
R31	3.9-ohm, 1W carbon
R34, R37	2-kilohm
R35, R36	1-kilohm
Capacitors:	
C1, C4	47µF, 63V electrolytic
C2, C8	10µF, 10V electrolytic
C3	0.22µF, 100V ceramic
C5, C6	25µF, 50V electrolytic
C7	200µF, 6V electrolytic
C9	100pF styroflex
C10, C11	0.1µF, 100V ceramic disc
C12	39pF styroflex
C13, C14	— 0.01µF, ceramic disc
C15, C16	— 10000µF, 100V electrolytic
Miscellaneous:	
LS	Loudspeaker (see text)
L1	See text
X1	33V-0-33V, 10-amp secondary transformer
S1	SPDT switch
F1	6-amp fuse with holder
F2	— 1-amp fuse with holder
	PCB, heatsink, coaxial cable, capacitor clamps, hardware, BNC plug/socket, enclosure, mains lead etc.

dissipation in the output transistor is then 100W. The transistor can, of course, withstand this.

The use of an output coupling capacitor is eliminated by using a symmetrical power supply. To connect this amplifier to a crossover network, be sure that the capacitors in it are non-polarised.

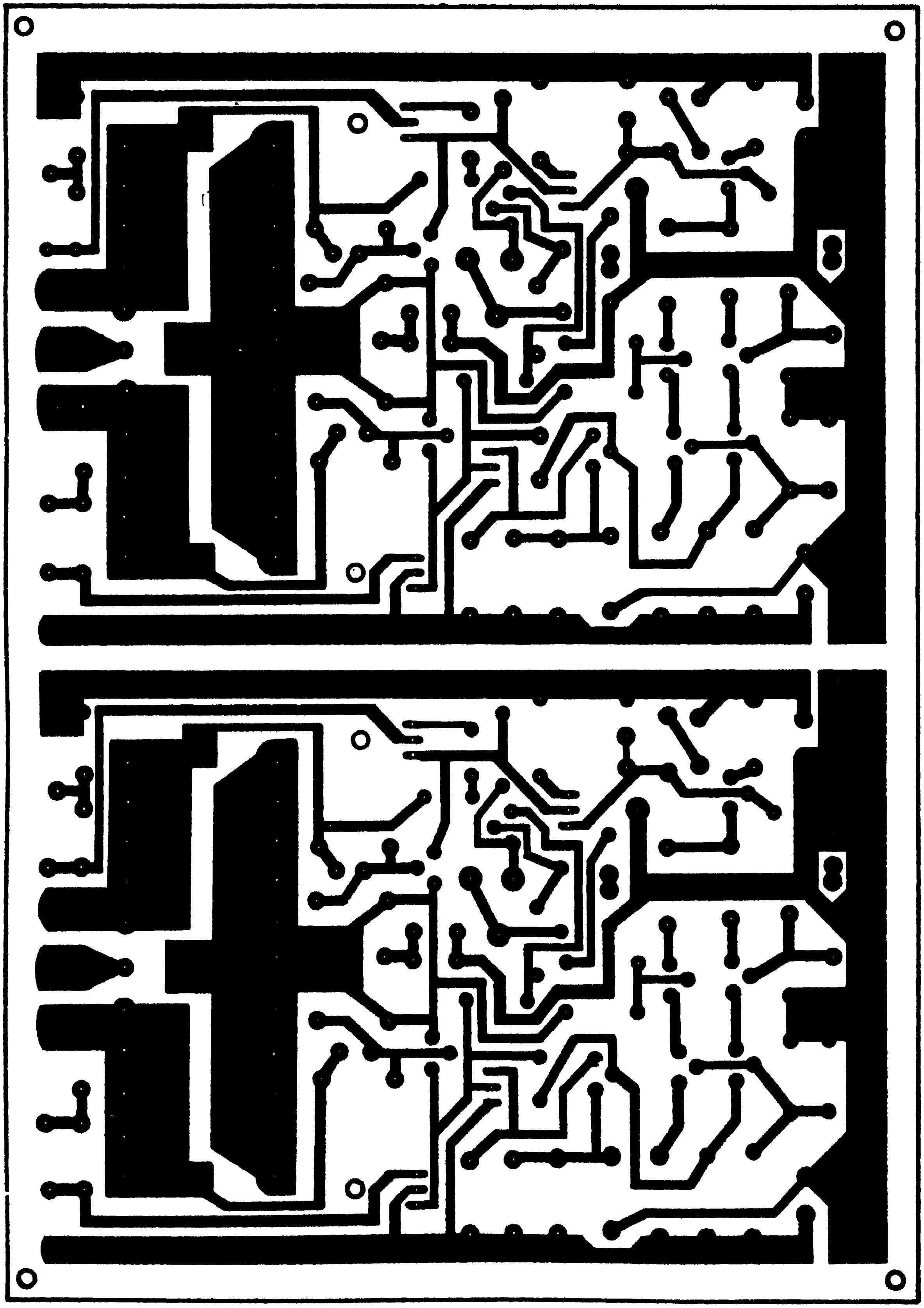
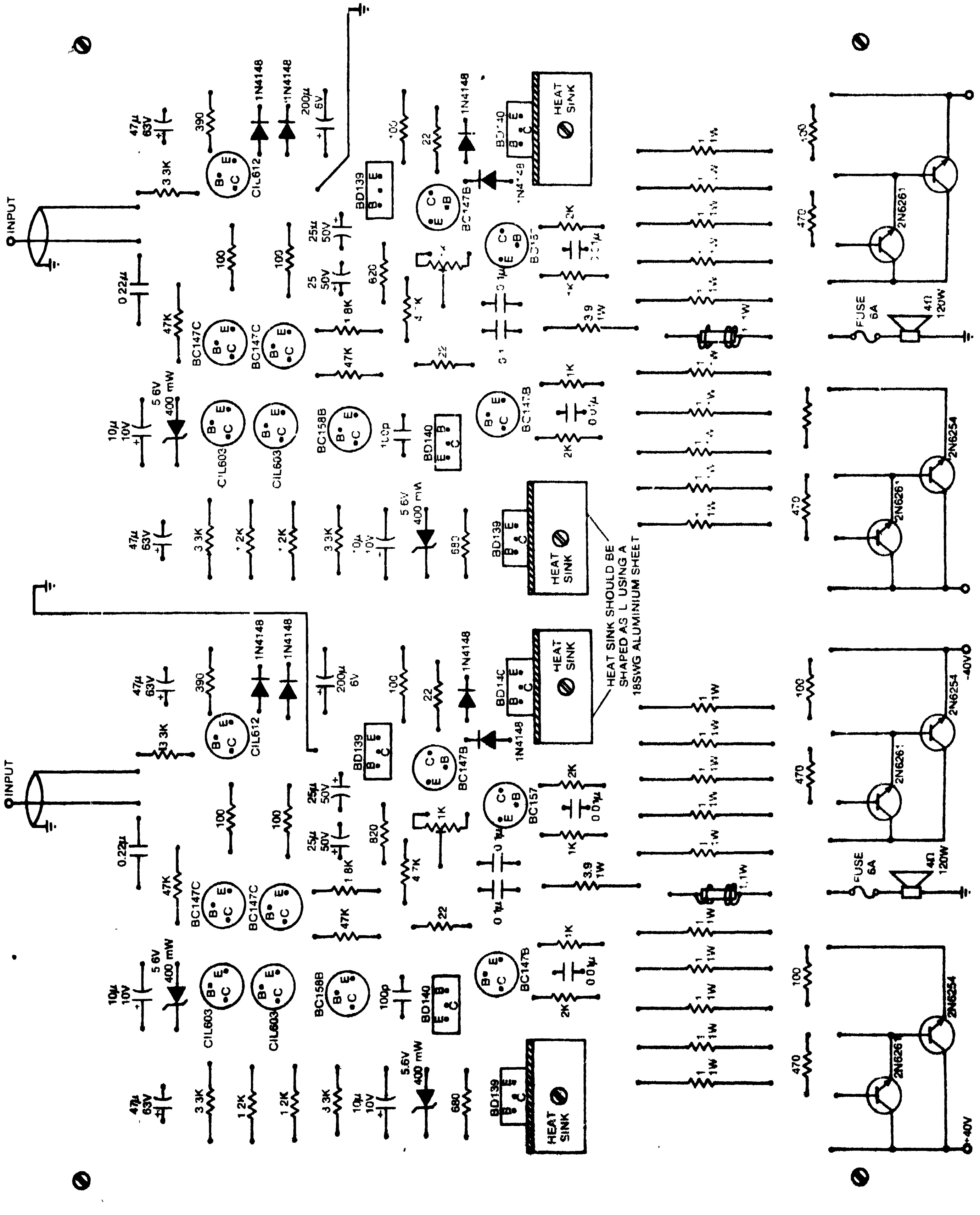


Fig. 2: PCB layout for 120W + 120W stereo amplifier.



NOTE: C12 (39p) SHOULD BE CONNECTED FROM TRACK SIDE IN PARALLEL OF R9 (47K)

Fig. 3: Components layout for 120W + 120W stereo amplifier.

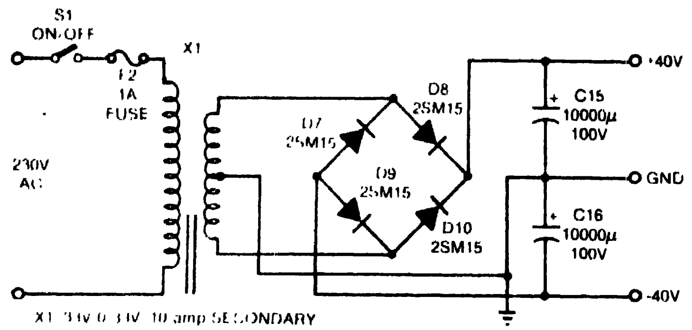


Fig. 4: Suggested power supply for the circuit.

Details of the Power Supply Components

Components	**Mono**	**Stereo**
Fuse (F2)	1A	2A
Capacitors C15 and C16	5000µF	10000µF
Diodes D7 to D10 Current(PIV ≥ 200V)	6A	12A
Transformer		
Secondary Current	5A	10A
Core Size	Tongue Width 6.25 cm Stack height: 5cm	Tongue Width 7.5 cm Stack height 7.5 cm
No. of turns in Primary SWG	460T 23 SWG	256T 20 SWG
No. of turns in Secondary/SWG	66T+66T 17 SWG	37T+37T 15 SWG

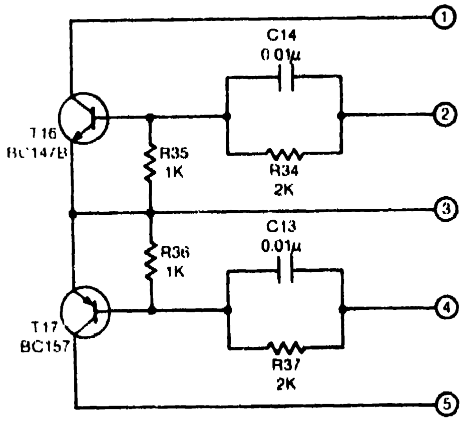


Fig. 5: Short circuit protection network.

Construction

The wiring should pose no problem if the PCB whose pattern is shown in Fig. 2 is used. When soldering components, solder all the resistors, except R21-R30, first. Then solder the capacitors and finally the transistors and the resistors R21-R30. There is no specific reason for this sequence. It is just that low-profile components should be mounted first. It will be easier to solder them in this sequence.

If soldering all the resistors R21 to R30 side by side poses any problem, first solder three resistors on each side and then solder the other two on top of them, on each side. Transistors T11 and T12 can be mounted on the same heatsink. The same goes for T14 and T15. The heatsinks must be of 1.2°C/W type. Use of silicon grease is advisable. The heatsinks for T6 and T8 are made by bending 1.2mm thick, 3cm × 2cm pieces of aluminium in 'L' shape. The longer arm of the 'L' should be screwed to the transistor and the shorter to the PCB. Only then should the transistors be soldered.

The fuse that is connected in series with the speaker can be fixed at the back panel of the amplifier. These fuses must be of quick blow type. All wiring must be made with 18SWG tinned wire or flexible wires that can carry currents up to 6A. Use separate power supply wires for each channel and separate speaker return leads.

Adjustments

After checking the wiring, turn VR1 clockwise fully or set to maximum resistance. Now connect a voltmeter, capable of reading millivolts, across the resistors R21-R25. Switch on the amplifier and adjust VR1 so that the meter shows 6 to 10 mV.

This is the only adjustment required. Connect a tape recorder or a tuner through a suitable preamplifier and tone control amplifier to enjoy the music.

Note: A suitable preamplifier designed and developed at EFY lab to go with this power amplifier will be published in the next issue to enable a complete hi-fi stereo amplifier system.

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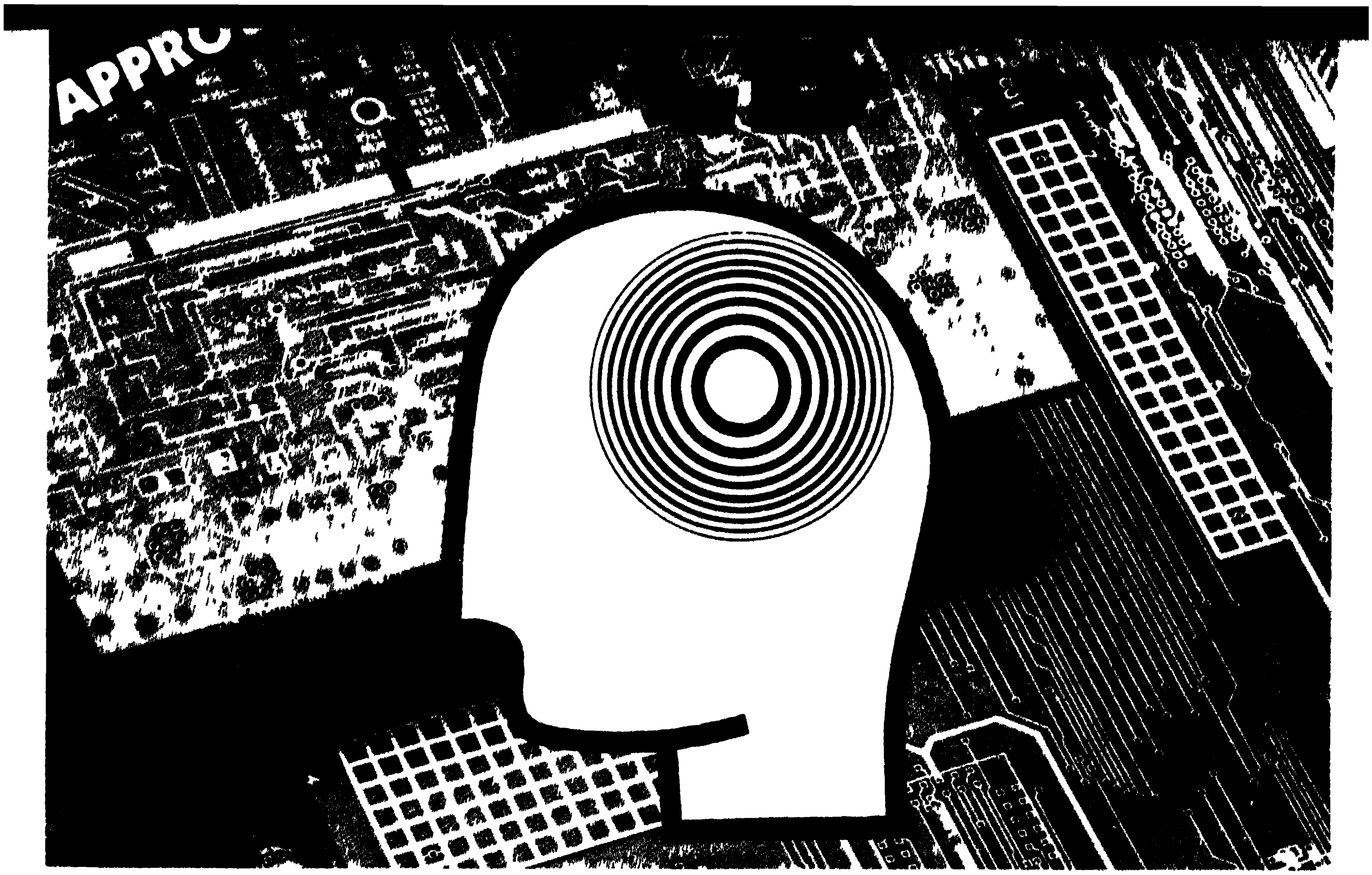

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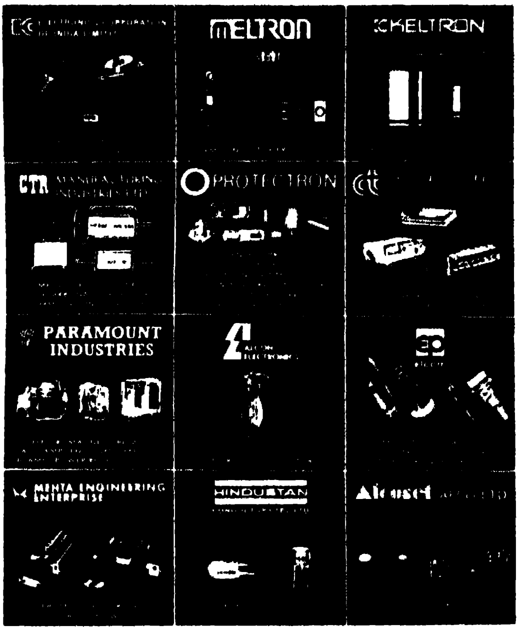
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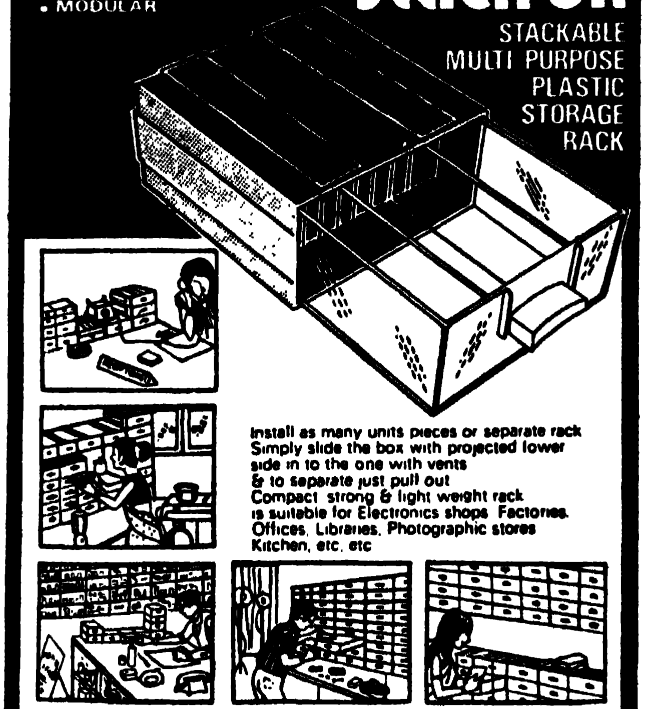

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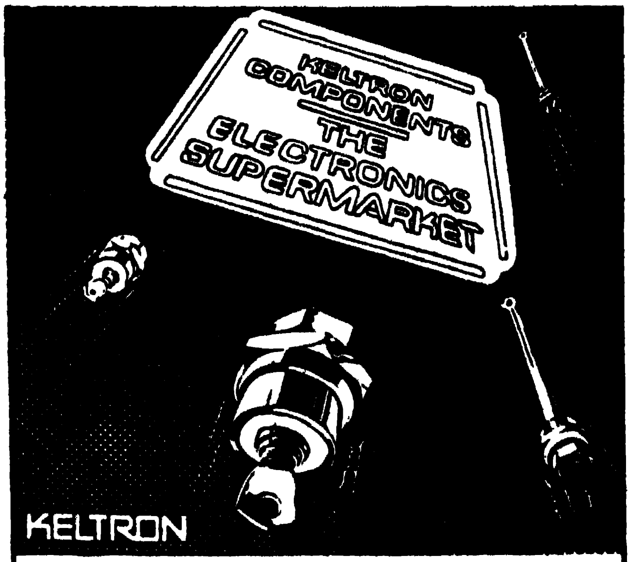

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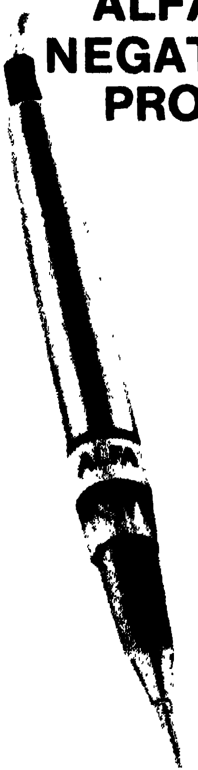

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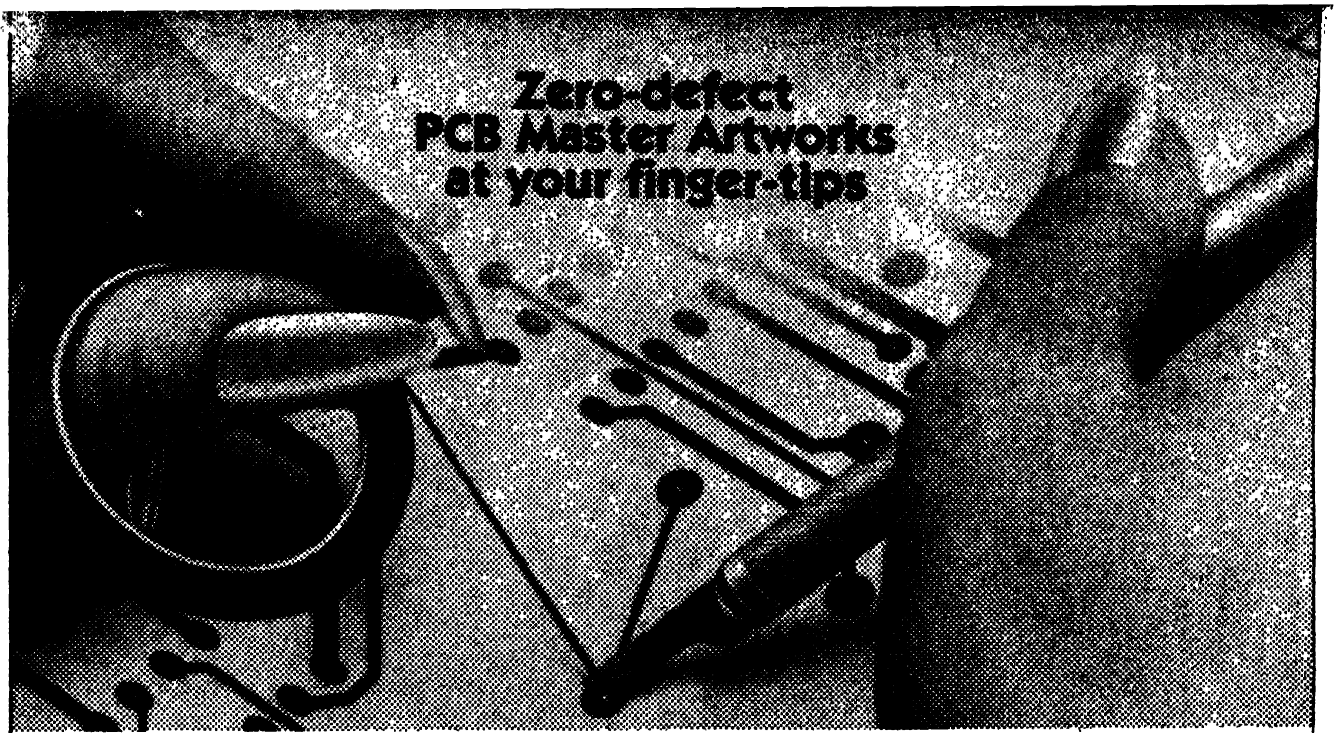

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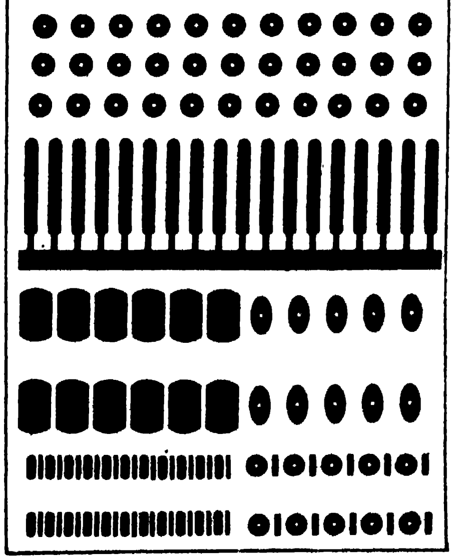

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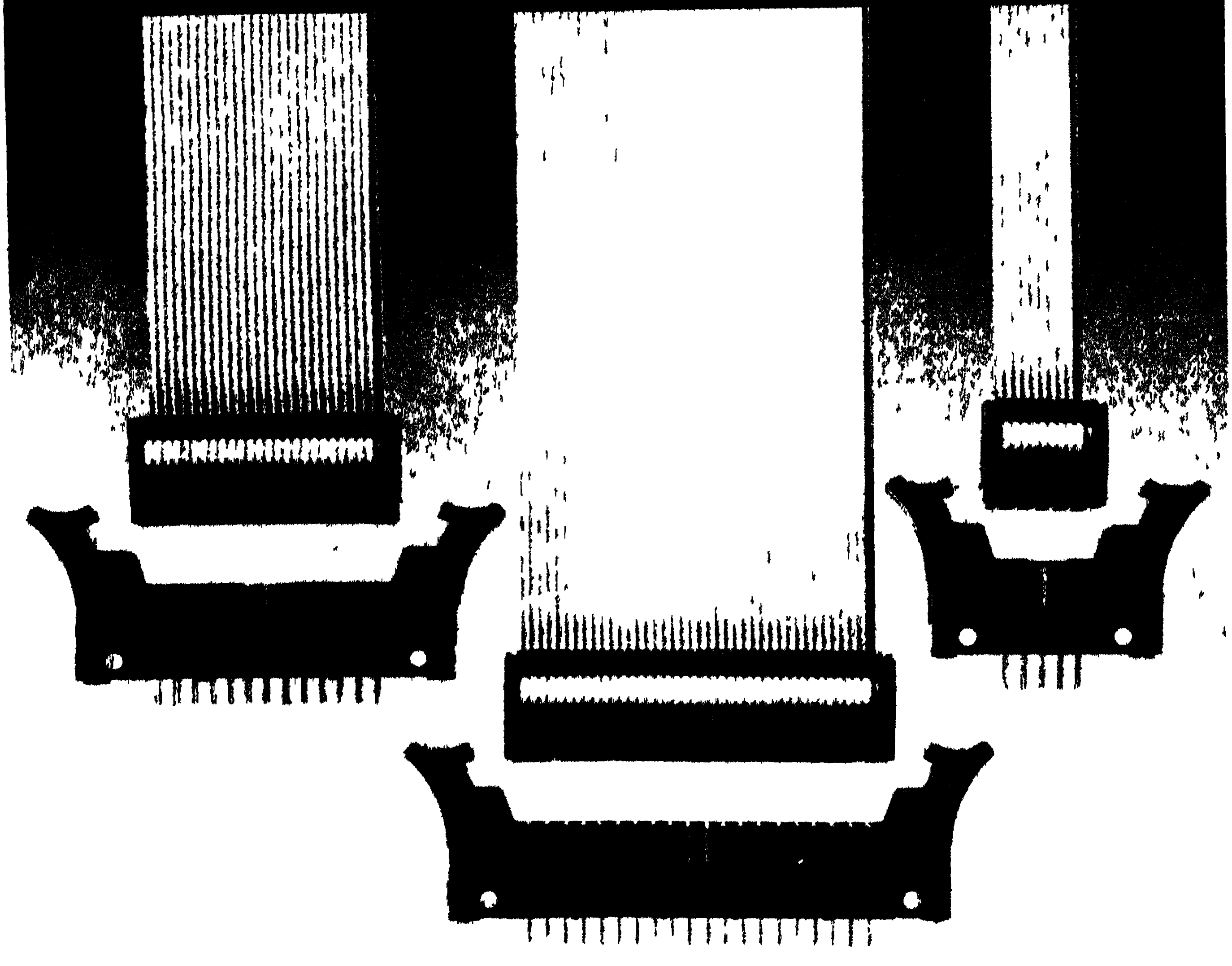

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Tarun Kumar Tripathy

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The model

The game should be housed in an enclosure which is fitted

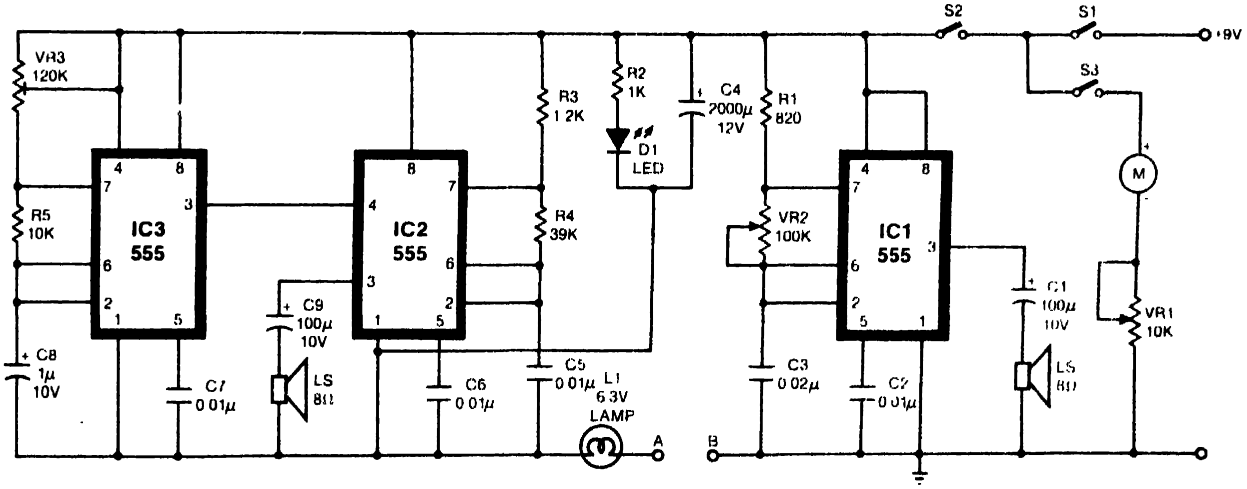

Fig. 1: Circuit diagram for car-racing video game.

PARTS LIST

Semiconductors:

IC1, IC2, IC3	NE555 timer
D1	5mm light emitting diode

Resistors (all ¼ watt, ±5% carbon):

R1	820-ohm
R2	1-kilohm
R3	1.2-kilohm
R4	39-kilohm
R5	10-kilohm
VR1	10-kilohm linear potentiometer
VR2	100-kilohm linear potentiometer
VR3	150-kilohm preset

Capacitors:

C1, C9	100μF, 10V electrolytic
C2, C5, C6, C7	0.01μF ceramic disc
C3	0.02μF ceramic disc
C4	2000μF, 12V electrolytic
C8	1μF, 10V electrolytic

Miscellaneous:

LS1, LS2	8-ohm tweeter
L1	6.3V, 0.5A miniature lamp
M	9-volt DC motor (without governor)
	tinned copper wire, polythene sheet, aluminium toy cars or sheet, typewriter ribbon spools, metallic roller, suitable enclosure, hardware etc.

with a screen (a hard polythene sheet), a steering wheel and some controls, as shown in Fig. 2(a).

The steering wheel arrangement is to be fashioned out of two typewriter ribbon spools, potentiometer VR2, an aluminium rod shaped as a steering wheel and a thin but strong copper wire, as shown in Fig. 2(b). The potentiometer's spindle may be ganged with the steering wheel so that the two rotate together.

In the middle of the copper string over the spools, a fancy racing car should be suspended. The 2cm car should be of aluminium sheet with copper bristles underneath, as shown in Fig. 2(c). The bristles can be charged through the copper wire.

All these should be fixed in the cabinet such that the racing car is seen moving across the screen on turning the steering wheel.

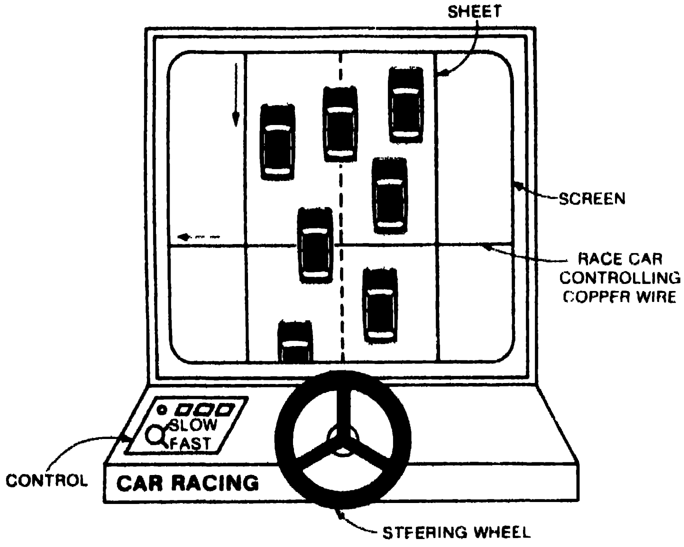

Fig. 2(a): Front view of the prototype.

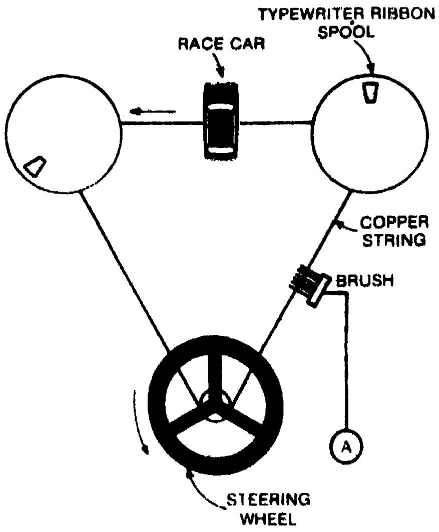

Fig. 2(b): Typical threading system for steering wheel arrangement.

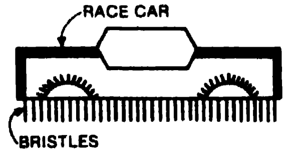

Fig. 2(c): Front view of the race car.

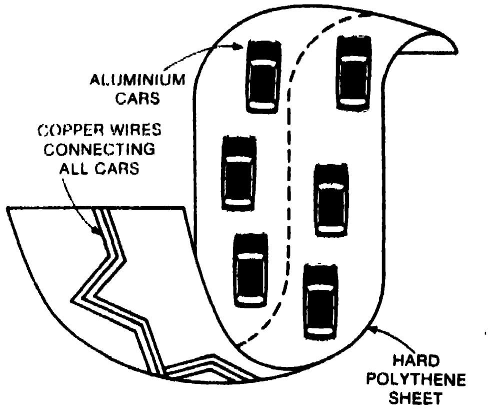

Fig. 2(d): Construction of road using polythene sheet.

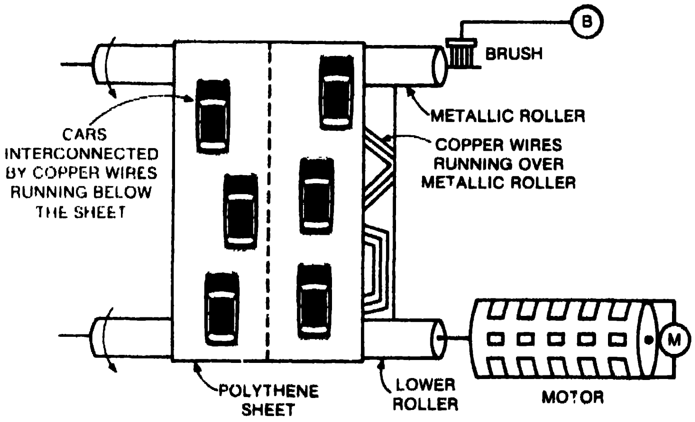
B
BRUSH
METALLIC ROLLER
CARS INTERCONNECTED BY COPPER WIRES RUNNING BELOW THE SHEET
COPPER WIRES RUNNING OVER METALLIC ROLLER
M
POLYTHENE SHEET
LOWER ROLLER
MOTOR

Fig. 2(e): Schematic showing the arrangement of polythene sheet over the metallic roller.

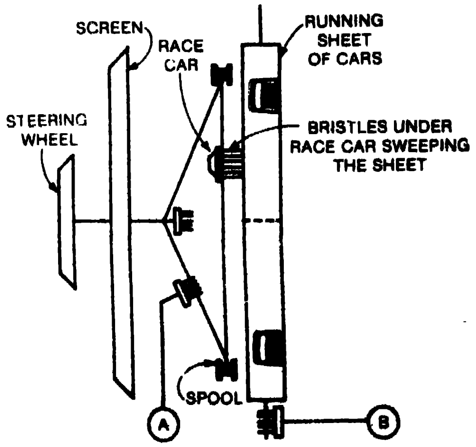

Fig. 2(f): Upper view of the mechanical assembly.

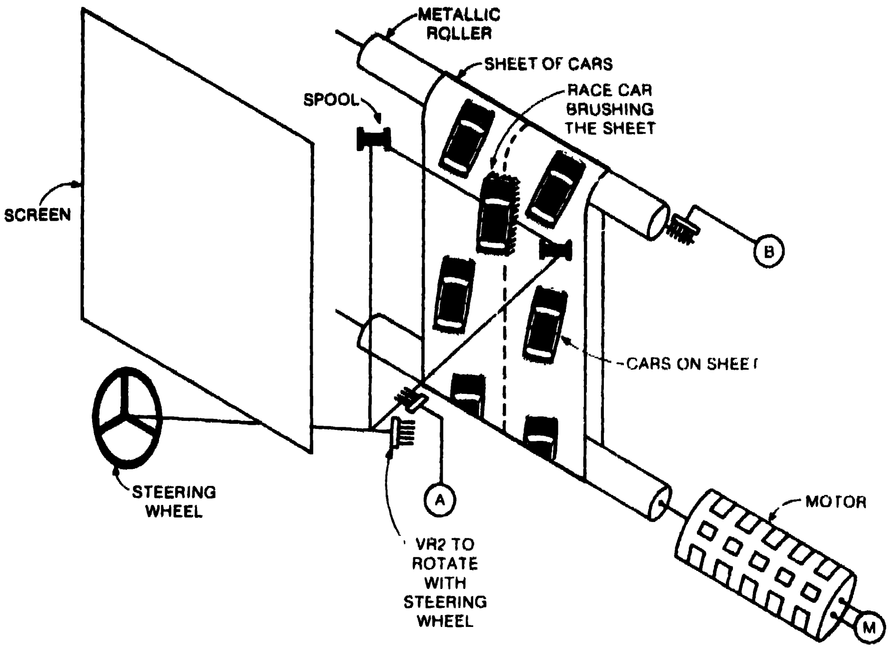

Fig. 2(g): Side view of the mechanical assembly.

Now about the other cars. These should be aluminium sheets cut out in the shapes of racing cars. They should be mounted on a translucent hard polythene sheet, cut out to resemble a highway. The aluminium cars should be interconnected by a thick bunch of copper wires running below the sheet, as shown in Fig. 2(d). The long sheet of paper should be connected like a belt and slipped over the two rollers, as shown in Fig. 2(e).

The upper roller should be metallic so that the copper wires under the sheet going over it carry current to each car whenever the roller is charged. The lower roller should be fastened to a motor whose speed is controlled by potentiometer VR1. The potentiometer should be on the control board to control the speed of the cars. A copper brush should be connected to point B of the circuit in such a way that it is in constantly in contact with the metallic roller. Another brush from point A of circuit, as shown in Fig. 2(f), should be in touch with the copper wire of the steering system. Now if the racing car touches any car on the 'road' it means points A and B of the circuit are connected.

Arrangement

The arrangement of the game should be made in this order:

1. Screen
2. Racing car controlled by the copper string and steering wheel
3. Sheet of cars running just below the racing car with the bristles of the racing car brushing the sheet as shown in Figs 2(f) and (g).

Now if we start the motor, the sheet under the racing car will move with the racing car brushing the 'road'. As the cars on the road go down the screen, the racing car appears to race up the screen. All you have to do is to steer the car from side to side on the 'road' without brushing any car. Once you fail to dodge an oncoming car and your race car touches it (i.e., A of circuit contacts B), lamp L1 flashes, indicating a crash; D1 glows for some time; a beeper beeps for a while, indicating the end of the game.

Extras

Switches, LED, VR1, etc should be on the control board. Printed circuit board, loudspeakers, etc should be suitably placed inside. Lamp L1 should be near the racing car. Many interesting modifications are possible. Inside of the cabinet must be illuminated to make the cars on the polythene sheet visible.

A tape recorder motor is made for constant speed requirements and thus varying VR1 has no effect on it. So it's better to use ordinary toy motors without electronic governor.

The circuit

The circuit is built around three 555 timer ICs. All the three ICs are associated with generation of an audio output. While IC1 and IC2 generate high frequency, IC3 is part of a low-frequency oscillator. The IC1 circuit generates a pleasant sound Potentiometer VR2 and capacitor C3 determine the frequency of the sound. As VR2 is connected to the steering wheel, the sound represents that of a speeding car when the racing car swings left and right. For a better effect the value of C3 should be increased.

When points A and B are connected, current flows through L1 and it flashes, while C4 stores up charge. Even though it is a momentary touch, the capacitor stores charge for the operation of the LED and the beeper. The time of operation can be extended by choosing higher values of C4.

IC2 generates high notes. IC3 produces 'ticks' through pin 3. The timing of the 'ticks' is controlled by preset VR3. Now we know that IC2 will oscillate only if the reset pin 4 is fed with some voltage. When IC3 begins to oscillate and delivers 'ticks' (voltage) to the reset pin 4 of IC2, IC2 oscillates accordingly and beeps are produced instead of ticks. Thus the frequency of the beeps is controlled by C5 and R4 (timing being controlled by VR3).

Rules of the game

Switch on internal light etc. Now turn on switches S1 and S3. The cars on the 'road' race down the screen and the racing car goes up the screen. Taking the racing car to one side of the 'road' by means of the steering wheel, switch on S2 and start steering through the speeding cars. Try not to collide.

The sound of your speeding car comes through LS1. When you collide the indicators are started. Note the time with a stopclock.

Don't be dismayed if your game lasts for only a couple of minutes. Try playing a slow game by adjusting VR1. With practice, proceed to fast racing car games. A week later, your professional video game pal won't stand a chance against you. Good luck! ☐

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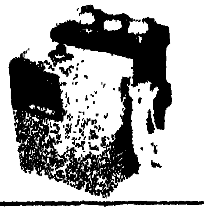

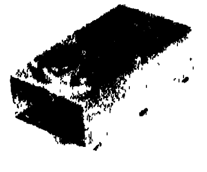

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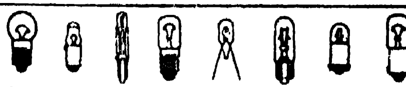

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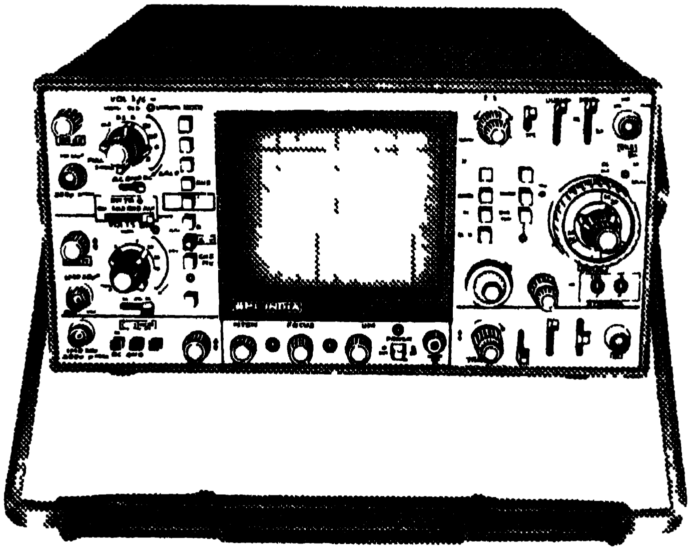

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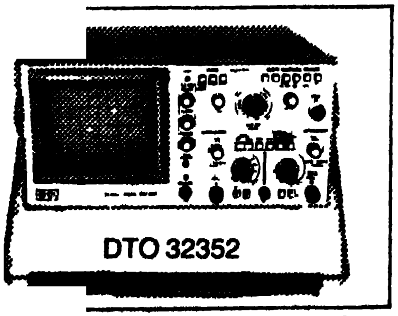

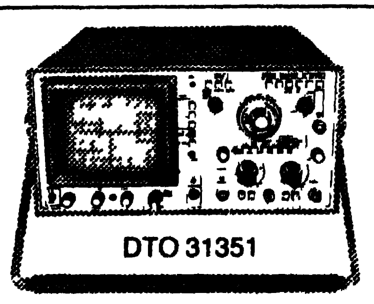

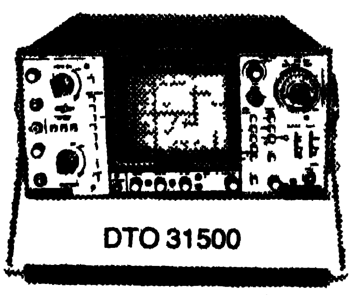

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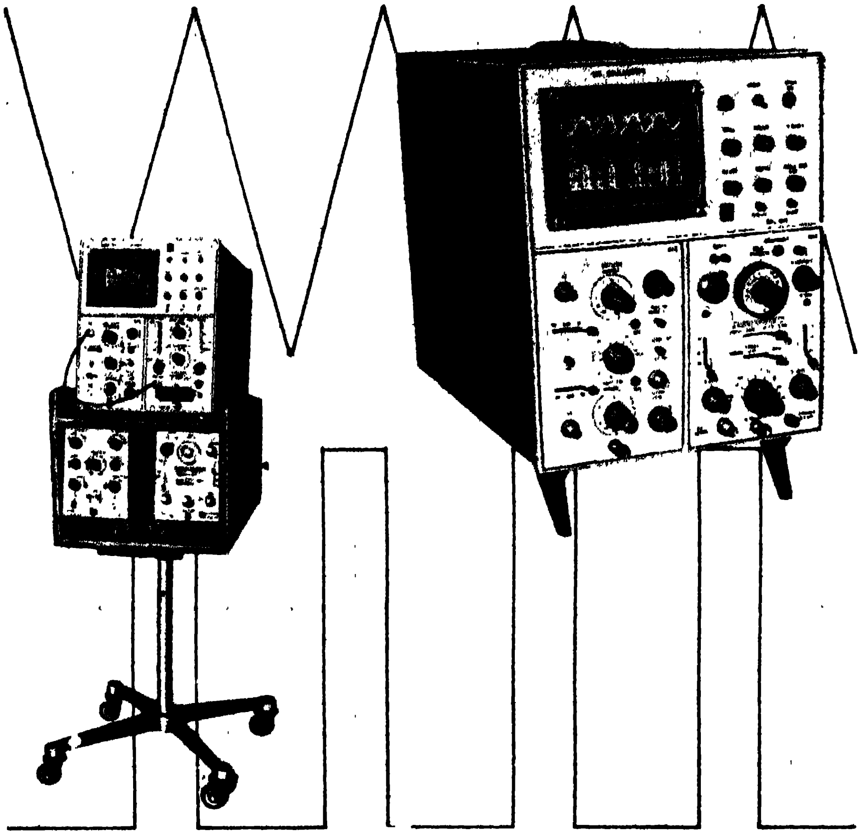

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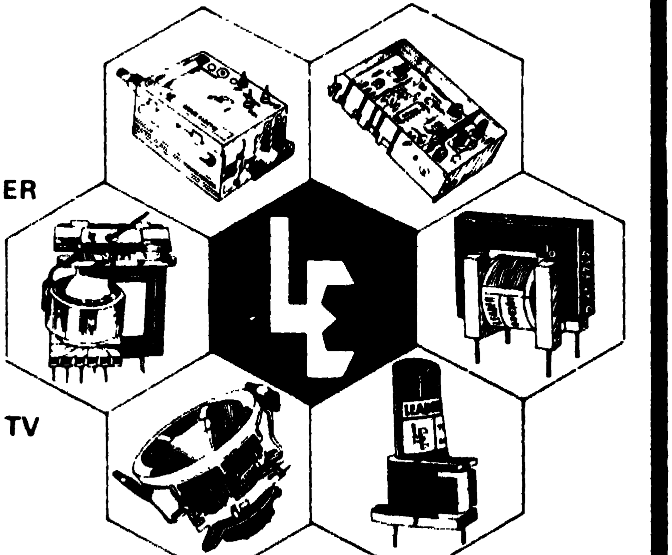

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It s an absolutely fool proof safe and permanent method designed to reduce the time spent on an electrical wiring installation The ladder style fastening method can be released and easily refastened Cable bundle diameter range 5 mm to 21 mm

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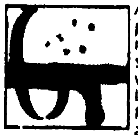
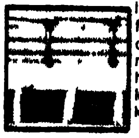
For fast secure edge holding of any size and width flexible flat or ribbon cable single or stacked Mount two ways adhesive backing or screw

Perforated Strapping



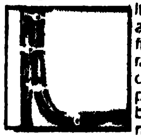
An efficient and very popular cable binding method using perforated strapping which s fixed with studs or cut to length for a very neat finish This is suitable for any size of cable bundle

Lacing Cord



It grips the cable bundle firmly which neither engrave the cable surface nor carves the operator s hand The resulting tie looks very neat and the knots are very fine

Easy-lok Cable Tie



Its design feature offers alternative degree of fixing either as a temporary measure prior to completing the wiring process or as permanent bunching device For modifications the tie may be removed by hand easily Available for cable diameter upto 26 mm

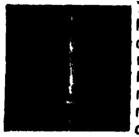
Novoflex P-Clip

These non conductive P clips are for fixing cables pipes tubes and components in domestic/industrial appliances electrical/electronic equipments and installations Manufactured in adjustable and non adjustable forms to suit cable sizes from 1 5 mm to 73 mm dia

Insulator Transistor Mounts

One piece design simplifies mounting of power transistors package TO 3 and TO-66 plus providing proper insulation and improved thermal efficiency These transistor mounts have a built in barrier which eliminate the need of sleeving of base and emitter connections also serves as assembly aid during instllation

Printed Circuit Board Supports



These non conductive PC B supports are designed for secure and rapid installation The supports have a plug-in fastening method to lower assembly costs and allows quick access for maintenance or equipment modification

Saddle-clip

A releasable cable binding method using binders with clip for unsupported wiring and saddle and clip for anchored wiring is designed to reduce wiring installation time Available for cable form diameter range 6 5 mm to 65 mm

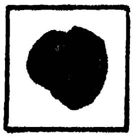
Alpha Binding Strip

This is ideal for securing cables to girders angle bars pipes and other structural steel work where it is not possible to drill or stud the steel work for a fixing

Skintite Cable Gland

General purpose gland for Plastic or rubber insulated unarmoured Plastic or rubber over sheathed cables

Nylon Bush



A range of metric make insulating bushes manufactured from Nylon are available in black colour

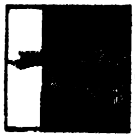
Nylon Locknut

These nylon locknuts have a host of application including use with glands and male bushes available in black colour

Flexible Grommet Ring

A selection of different sizes of flexible grommet rings are available to protect wires cable cords against damage from sharp panel edges and insulate holes of steel sheets

Continuous Grommet Strip



Low cost cut to fit grommeting protects cables/wires from sharp panel edges and knock outs Available in continuous length

Novorim Edging Strip

Ideal for covering potentially dangerous sharp edges as found on bulk head cut outs instrumentation enclosures control panels etc It can be easily applied to external or internal radii as well as straight edges

Hygrip Cable Marker

A versatile range of marker available for cables having diameters of 2 75 to 35 mm Its shaped end cut ensures simple positive and accurate alignment of legends permanently with a non slip grip even in hostile environment Cables from 1 0 to 95 sqmm are covered in only four sizes thus reducing inventory of stocking various sizes and eliminates the problem of marker found too tight or too loose

Melagrip Cable Marker

The most popular and economic cable marker Available for cable diameter range 1 75 to 11 5 mm Available in Pre cut chain from also

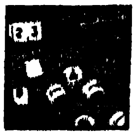
Interlocking Cable Marker

These can be assembled with figures in line and the key ensures that it cannot come out of alignment afterwards Available for cable sizes 1 5 to 50 sqmm

Ovalgrip Cable Marker

These are oval in section and are fitted by pressing into a circular shape sliding over the cable end or terminal and then releasing Available for cable diameter range 0 9 to 6 0 mm

Clip-on Cable Marker



These markers clip over the cable insulation and are primarily intended for use after terminating cable ends This feature facilitates modification to wiring code when necessary

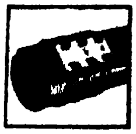
Sleeve Cable Marker

These thin walled markers are particularly recommended for high density wiring since virtually no increase in the overall diameter of the insulated cores takes place Available for cable diameter 0 75 to 35 mm in semi cut form

Terminal Block Marker

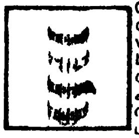
These can either be slipped into the terminal block tag slots before the terminals are mounted in assembly or can easily be pressed home into the slots after terminal banks have been built up Available for terminal block size upto 35 sqmm in pre cut strip form

Alpha Cable Marker



This offers a practical method of applying permanent and legible markings to large cables

Ovalstrap Cable Marker



Ovalgrip cable markers can be combined with a variety of Novoflex binding accessories viz cable ties Alpha strip to achieve several methods of identifying large diameter cables Cable bunches and conduits

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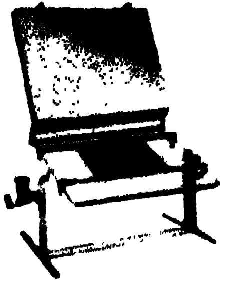

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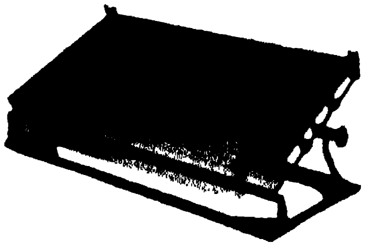

FLOWLINE

Model		Max PCB Dimensions in M.M
Uni	Flow	
IS 1	ISFL 1	265 x 400
IS 2	ISFL 2	300 x 450
IS 3	ISFL 3	200 x 500
IS 4	ISFL 4	325 x 550

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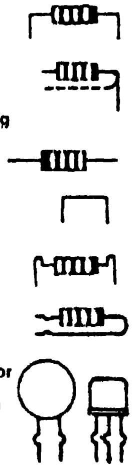

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Jumper link

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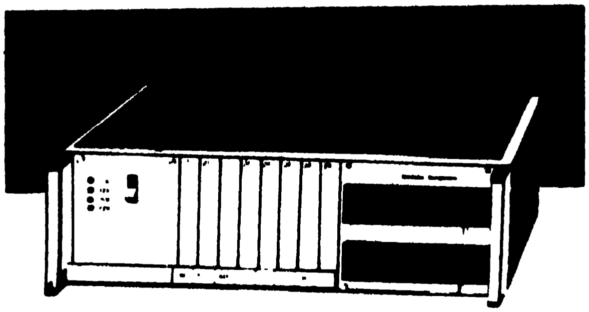

MODULARITY

The Hardware is designed in standard Eurocard Modules based on the function. All Modules are interconnected through Euro-bus back plane By this design philosophy it is easy to service, upgrade and develop new boards

HOUSING

The Central Processing Unit is housed in standard 19" Rack All the modules and floppy drives (in case of development system) fit into the 19" Rack - This design ensures high reliability and resistance to vibration

EUROBUS

Eurobus is modern bus architecture gaining wide popularity in Micro Computer Systems. All Boards on this bus can be memory-mapped and can be wired for special functions. The indirect Euro Connectors is another element in ensuring reliability and vibration resistance.

OPERATING SYSTEM

AE-8000 runs on CP/M OS which is specially made for Z80A processor board. The user has the freedom to configure other operating systems and CPU Modules if he so wishes

APPLICATION

AE-8000 may be used as a development system for Micro Processor Software. The programme so developed can be burned-in EPROMS These EPROMS can be placed on CPU Boards and configured in a 19" Rack 8010 as a target Micro Processor Based System. AE-8000 can be used as an industrial computer and for data processing as well. AE 8000 has free slots for user defined hardware modules

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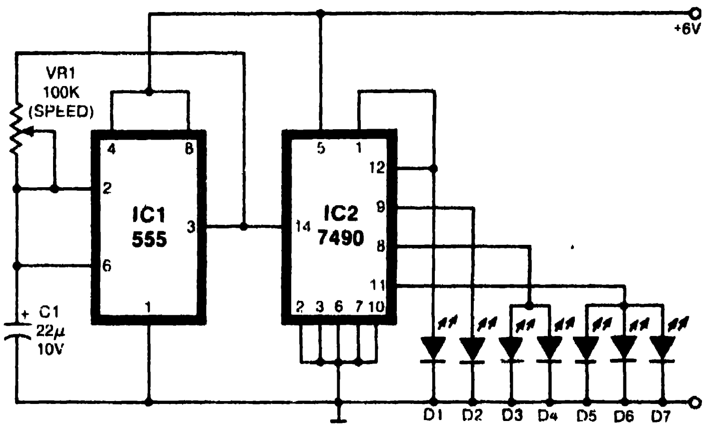
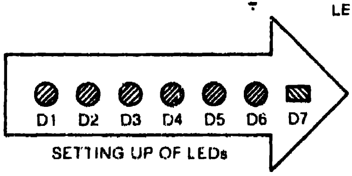
LED Direction Indicator

This circuit, being economical, can be used in place of blinking indicators in bikes or on the instrument panel in cars etc. The circuit uses the 555 timer IC for pulse generation and IC 7490 as the BCD counter. The LEDs, if positioned closely in the same manner as shown, appear to move in one particular direction when the frequency of pulses is increased. If the frequency is too high, all the LEDs appear to glow at the same instant.





The binary outputs of 7490 as it counts from 0 to 9 are given below:

COUNT	Q3	Q2	Q1	Q0
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

If the LEDs are connected across the output, '1' indicates that the LED lights up. Here '1' appears to be moving left as counting progresses. Hence the light appears to move left if the counting is fast enough so that the individual flickers are not visible.

IC 7490 has been used instead of IC 4011 since the circuit can also be used to check if the ICs 7490 (or 7493) are good.

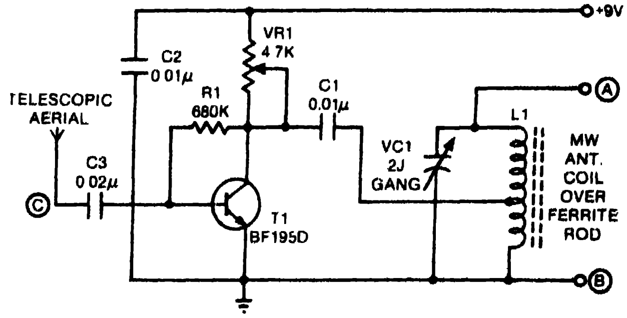
It is interesting that a digital IC specifically designed for binary counting can also be used in a project entirely different from the one for which it is intended.

RAMESH R.

SW AM Booster for Valve Radio

Here is a low-cost project that can pack a lot of extra power into an old valve-type, weak radio receiver which cannot receive shortwave (SW) signals without an external aerial. It can also be used with a 2-band transistor receiver to boost the SW signals. Besides, it permits extensive broadcast band DXing with any simple AM radio receiver.

The transistor T1 (BF195D) is wired as a common-emitter RF amplifier with base bias taken from the collector and also forms a tuned circuit along with L1 and VC1. Collector voltage is taken from the positive rail through a variable potentiometer VR1 as it should be varied for getting the desired performance. VC1 must be adjusted for optimum performance and shortwave DXing. Point A should be attached to a crocodile clip and then connected to the aerial points of the receiver. A small telescopic aerial should be attached over the cabinet of the booster from point C as shown in the circuit diagram.



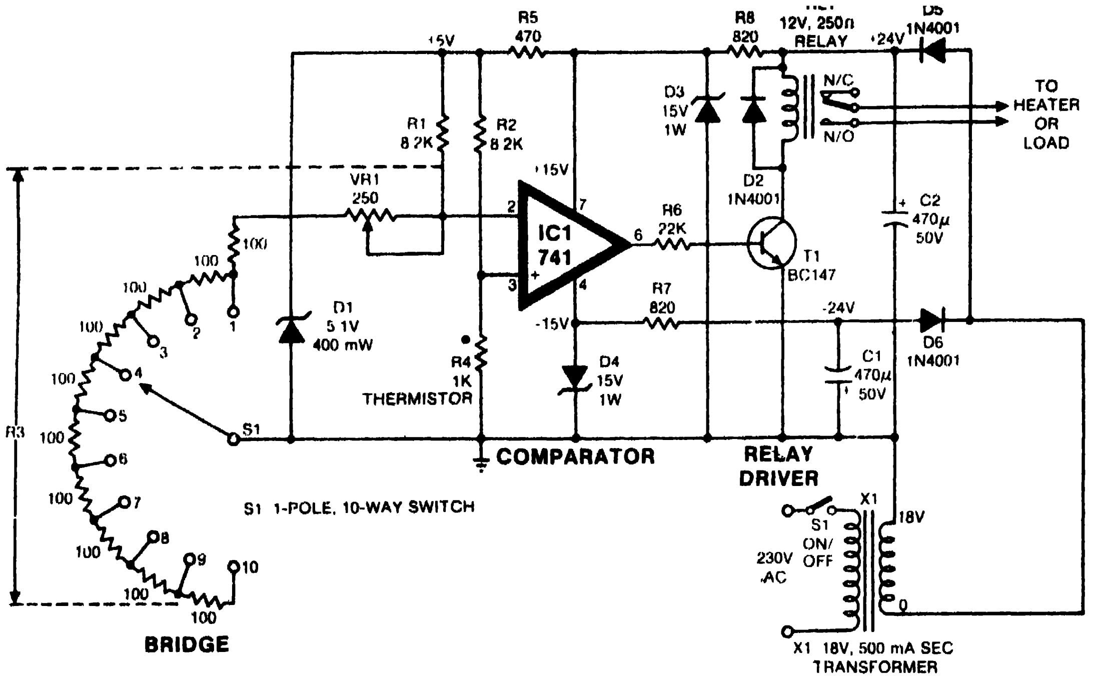
Assemble the unit on a small general-purpose veroboard. House it in a small plastic cabinet with the antenna coil L1 and the ferrite rod cemented to the side or back of the cabinet using an adhesive like araldite for best performance. Adjust coil L1 over the ferrite rod before cementing it on to the cabinet. The unit should be positioned parallel to the built-in antenna coil of the receiving set.

MUKUND H. TODMAL

A Simple Temperature Controller

Here is the circuit of a simple and inexpensive temperature controller which can control temperature from about 20°C to 200°C with an accuracy of 0.5°C.

The controller has been designed and fabricated using the



op-amp IC 741 and a 1k thermistor as the temperature sensor. It is based on the principle of wheatstone bridge. The ratio arms R1 and R2 of the bridge are kept fixed (say unity). The voltage across the thermistor, i.e. across the arm R4, is compared with the voltage across the variable arm R3 which is kept fixed for a particular temperature (using the op-amp).

When the bridge is not balanced the output of 741 drives transistor BC147 to conducting state. Thus, the relay is energised and switches the heater on. As the temperature increases, the voltage across the thermistor decreases and when this voltage is equal to the voltage across R3 (i.e. the preset value) the output of 741 becomes zero. The transistor then stops conducting, the relay is de-energised, and the heater is switched off.

Bandswitch S1 gives the different ranges of temperature and potentiometer VR1 is used for fine adjustments

Dr D.K. KAUSHIK

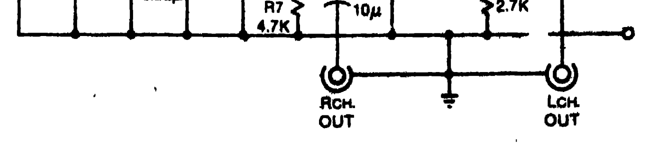
Mono to Stereo Converter

This circuit utilises both the selective frequency technique and the anti-phase technique for converting the monophonic sound in radios, tape recorders and TVs to stereophonic sound.

In stereo recordings, the treble sounds are usually more dominant in the left channel, while the heavy, bass sounds are prominent in the right channel. But in a mono recording all the sounds are recorded on one channel. Hence the purpose of this circuit is to split the audio signals such that the signals of lower frequency are fed to the right channel speaker, while the signals of higher frequency are fed to the left channel speaker. But this selective frequency method produces only a central stereo image or effect.

So to experience the stereo space wide effect, the anti-phase technique of mono to stereo conversion is also used. This means that signals opposite in phase are separated and one group is fed to right channel and the other to left channel speakers, due to which we experience an increased stereo channel separation. This is brought about by operating switch S1.

T1 operates as an emitter-follower buffer stage so that the two filter stages around T2 and T3 are fed from a low-impedance source. The left-side filter stage T2 utilising R4 and C4 acts as a low-pass filter and ensures minimum loading on low-pass filter. The right-side filter stage T3 utilising R8 and C6 acts as a high-pass filter and, while ensuring minimum loading on the high-pass filter, also functions as a phase splitter. When S1 is switched to position E, no phase inversion of output takes place as T3 acts as an emitter-follower stage and hence only converted central stereo sound is obtained. But when S1 is switched to position C, phase inversion of the output takes place as T3 now acts as a



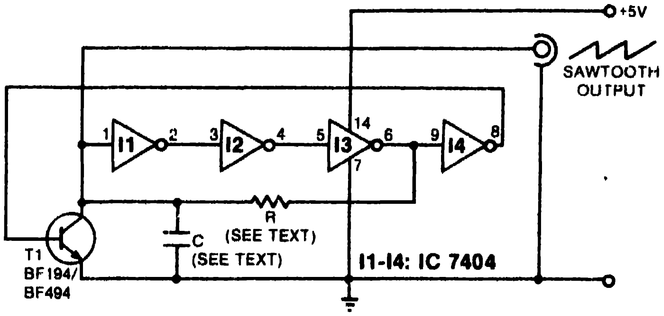
common-emitter stage with 100 per cent negative feedback due to resistance R11. This provides a 180° phase shift with respect to the right channel which causes an illusion of increased channel separation.

S.N. SHEWALE
S.K. HIRAY

Simple Sawtooth Generator

This easy-to-make sawtooth generator circuit uses one inverter chip and a transistor. IC 7404 (hex inverter) is used for frequencies up to 100 kHz and IC 74S04 (schottky TTL) for frequencies between 100 kHz and 20 MHz. The frequency can be changed by changing the product RC.

Let us suppose the input of gate 1 is at logic '0' state and outputs of gates 3 and 4 are at '1' and '0' respectively. The transistor T1 is 'off' and capacitor C gets charged through R.



When it is charged to a voltage equal to logic '1', all gate outputs change and T1 is 'on', resulting in quick discharge of stored charge in C through it. So, the input voltage of gate 1 becomes '0' again and the next cycle starts.

One should choose values of R and C such that the time needed to charge capacitor C from logic '0' to logic '1' state is slightly less than the time period of oscillation. This circuit works efficiently, especially at high frequencies, provided stray capacitances and inductances are very small.

LAB NOTE: 'R' was taken as 22k and 'C' as 4.7μF (10V) for testing to see the sawtooth waveform in our lab.

SURAJIT DEY

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PUSH BUTTON SWITCHES
1/5 Amps. 3 way with Off positon

ROTARY SELECTOR SWITCHES
16/30 Amps upto 6 positions & 4 poles

MINIATURE MICRO SWITCHES
Basic & with actuators

ROCKER SWITCHES
Single/Double pole. 6 & 16 Amps rated Also illuminated

ROTARY SWITCHES
1/3 Amps. upto six positions

TRIGGER & SLIDER SWITCHES
For Electric tools. AC/DC 10 Amps

CENTRIFUGAL SWITCHES
single or upto 3 HP Motors, 22/19 mm, 1500/3000 RPM

FOOT SWITCHES
10 Amps AC/DC Double pole ON/OFF

PROXIMITY SWITCHES
Inductive. 5 to 20 mm AC/DC

PUSH BUTTONS
5A & 10A
1 NO + 1 NC

CORD SWITCHES
1 Amp/250 V AC OFF/2 way

Indian Engineering Company
P.O. Box 16551, Worli Naka, Bombay-400 018.
Phone: 493-9544, 493-5565, 493-2805.
Grams: AMPVOLT. Telex: 11-75217 IERG IN.

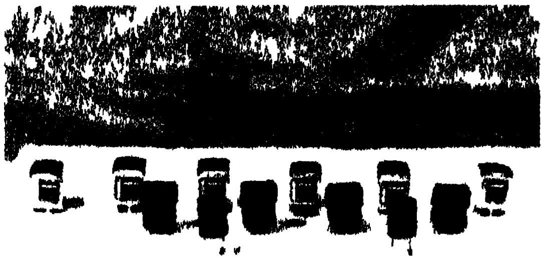
Medpub-874

ATTENTION

TELEVISION AND RADIO MANUFACTURERS

PERFECT ELECTRONICS PVT. LTD. MANUFACTURERS OF DEFLECTION COMPONENTS (DEFLECTION COIL, LINEARITY COIL, LINE DRIVER TRANSFORMER AND LINE OSCILLATOR COIL, ETC)

HAVE PLEASURE IN ANNOUNCING INTRODUCTION OF 10mm R.F. AND I.F. COILS, PEAKING COILS AND CHOKES OF ALL TYPES FOR RADIO AND TELEVISION.



ABOVE COMPONENTS ARE MANUFACTURED UNDER THE BEST TECHNICAL EXPERTISE.

WRITE WITH SPECIFICATION OR SAMPLE TO:

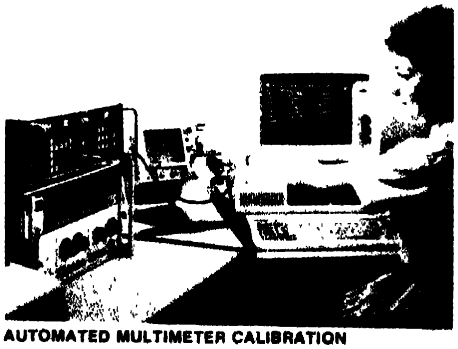
M/s. PERFECT ELECTRONICS PVT. LTD.

M-4, Dr V S I ESTATE, II PHASE, THIRUVANMIYUR,
MADRAS-600041

Product Profiles

AUTOMATED MULTIMETER CALIBRATION

PPM Compucal series 1000 Automated Calibration Systems, for both analogue and digital multimeters with or without IEEE Bus, calibrates all measurement parameters of almost all types of analogue and digital multimeters.

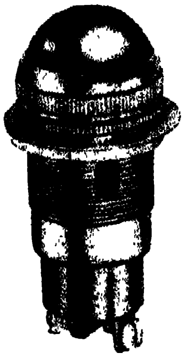

AUTOMATED MULTIMETER CALIBRATION

These are supplied with all necessary hardwares and softwares, depending on the required measurement specifications from the users.

Contact: Neotronics International, Post Box 7754, Bombay 400080.

INDICATOR LIGHTS

Electrols manufactures Indicator Lights to international standards in three sizes to accommodate lamps/neons with bayonet caps type Ba15d/17, Ba9s/14 and Midget-6. Lenses are available in glass for incandescent lamps or plastic for low-wattage lamps or neons in different colours. Choice of terminals like solder, screw or kliptite are optional.


INDICATOR LIGHTS

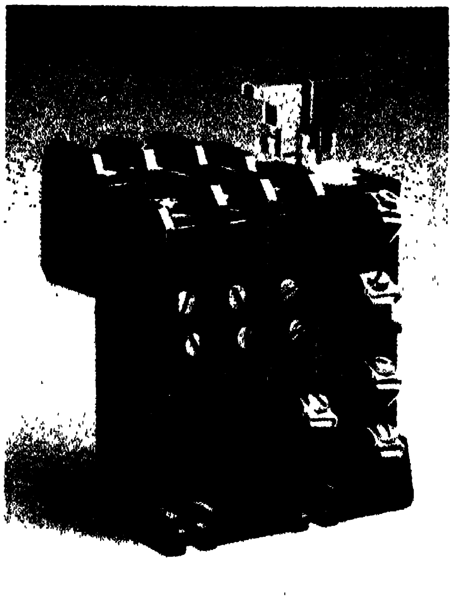
Lamp bases are moulded in melamine and housings are brass-chrome plated. Indicator lights are spring-loaded for positive contact.

Contact: Electrols, A27-28, Royal Industrial Estate, Naigaum Cross Road, Bombay 400031.

THERMAL OVERLOAD RELAY

A new compact, versatile Thermal Overload Relay has been developed by Larsen & Toubro Limited (L&T), to meet the requirements of original equipment manufacturers, panel builders and users in all industries. Designated MN2, it operates on the differential system of protection to provide greater protection for motors under both single phasing and overload conditions with its double-slide mechanism.

It also has other exclusive features such as, built-in, electrically separate 1NO + 1NC contacts for alarm and trip indication, integral 'start' and 'stop' buttons with reset combined with 'start', and an auto-manual slide for quick conversion at site from auto to manual and vice-versa. MN2 is provided with a generous terminal capacity for lugs up to 10mm².


THERMAL OVERLOAD RELAY

The relay is available in ratings from 0.09-0.15A to 14.0-23.0A in 14 settings for motors upto 15 hp (11 kW).

Contact: Larsen & Toubro Limited, (Switchgear Standard Products Division), P.O. Box 278, Bombay 400038.

DIGITAL ELECTRONIC INTERCOM

S.N. Electrotalk Industries' Pigeon 91A is a fully automatic, all-to-all, Digital Electronic Intercom, developed for the first time in India using the revolutionary 'simple cabling concept'. It does not contain any 'central junction box' and does not require multicore cable.

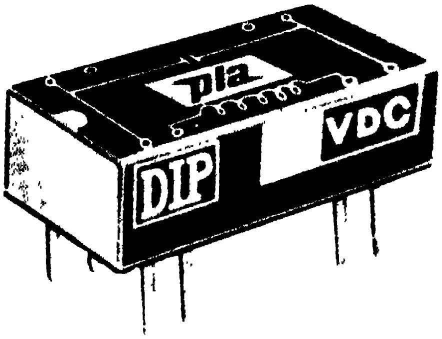
Its features include easy expansion in small steps of one or more stations at a time, minimal maintenance, sleek appearance, completely secret conversation, and an optional, specially designed, uninterrupted power supply. The system is economical. The very low installation cost due to use of only a single length of a three-core cable adds to its economy.

DIGITAL ELECTRONIC INTERCOM

Contact: S.N. Electrotalk Industries, Sinhal Agency Building, Sevoke Road, Siliguri 734401.

DIP REED RELAY

Sai Electronics' PLA series DIP Reed Relay is available with true one C/O and two C/O contacts, besides one N/O and two N/O contacts. C/O reed relays are preferred to reed relays with N/O + N/C contact combination due to compact size and positive operational reliability. Ideally suitable for mounting on standard dual-in-line IC sockets, the reed relay is available with various coil voltages with contacts capable of switching 10W/VA at 0.5 amps (100V Max.). Salient features also include high speed switching and excellent input to output isolation characteristics.



DIP REED RELAY

Contact: Sai Electronics, (A Divn of Starch and Allied Industries), Thakor Estate, Kurla Kirol Road, Vidyavihar (West), Bombay 400086.

AC MAINS POWER GENERATOR

Access Enterprises has developed a sleek and reliable 150VA inverter-cum-battery charger to prevent power failures and consequent interruptions to TV and VCR programmes. The unit comes 'on' automatically when

power failure occurs. External 12V/24V batteries get charged automatically. Suitable for car battery or maintenance free battery
Contact Access Enterprises, 234, Jaygopal Indl Estate, Bhawani Shankar Road, Dadar, Bombay 400028.

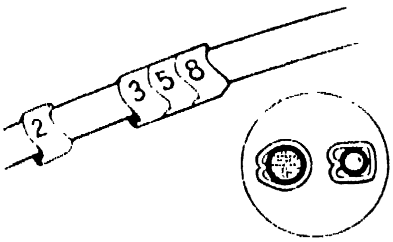
FLOAT CHARGER

Laktham Electronics has developed a Float Charger with 230V 50Hz, single phase input and output of 24V at 40 amps as a rectifier and 23V to 29V at 10 amps as a charger

The battery current is monitored continuously and when the battery requires charge, the rectifier is programmed automatically to charge at a constant current rate When the battery is fully charged, the rectifier reverts to float mode and supplies trickle current to keep batteries in a healthy condition
Contact Laktham Electronics, 744, 15th Cross, J P Nagar VI Phase Bangalore 560078

CABLE MARKERS

Novoflex Cable Care Systems introduces a versatile range of markers made from high-quality, flexible nylon enabling easy fitting without the aid of the tools These cable markers are available for cables having diameters of 2 25 to 35 mm Its shaped end cut ensures simple, positive and accurate alignment of legends Standard markings available are A to Z, 0 to 9, [illegible], blank The main advantage of these cable markers is that one particular size accommodates cables of various diameters, thus reducing inventory of stocking various sizes of markers and eliminates the problem of marker found too loose or too tight Only four sizes of markers cover the cable diameter range of 2 25mm to 23mm Service temperature range is -40°C to +95°C
Contact Novoflex Cable Care Systems, Post Box No 9159, Calcutta 700016.



CABLE MARKERS

DIGITAL PANEL METER

DIC's Digital Panel Meter D1-80 is a 3½ digit panel meter It is available in two basic ranges of 200mV and 1 999V, DC operating at ±5 volts. For a wide range of parameters suitability, DPMs for measurement of high DC and AC volts, ohms and DC and AC current are also offered. It is also provided with autopolarity, over-range indication and programmable decimal indication. Other options are also available with facilities like mains operation multiplexed or parallel BCD outputs, 'hold condition, use of external reference etc
Contact Digital Instruments Corporation, N B Chamber, Opp Canara Bank, Saijpur Bogha, Naroda Road, Ahmedabad 382345

DIGITAL PANEL METER

BREAKDOWN VOLTAGE TESTER

Spectron's Breakdown Voltage Tester measures reverse breakdown voltage of diodes and collector-emitter and collector base breakdown voltages of transistors This tester measures breakdown voltages up to 1000V at constant currents settable from 0 to 10 mA DC

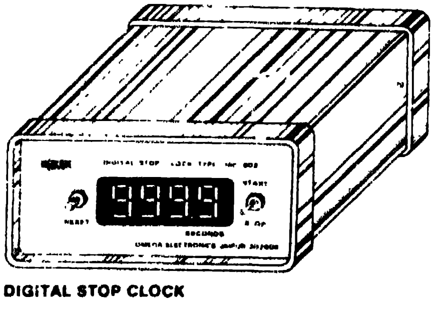
BREAKDOWN VOLTAGE TESTER

The instrument is very useful for manufacturers and bulk users of transistors It saves a major portion of costs of rejections, replacements at later stage (during testing of assemblies), cost of time spent in fault finding, etc
Contact Spectron Sales & Service Pvt Ltd, 63, Bharatkunj No 2, Erandvane, Pune 411038

DIGITAL STOP CLOCK

Omega offers a four-digit quartz-controlled Digital Stop Clock type DSC-602, having accuracy of ±0 01 per cent and range from 0 to 999 9 seconds The 'start/stop' operation is by means of mini-toggle switch and 'reset' by a pushbutton 'Reset' is possible only in 'stop' mode to avoid accidental resetting while the clock is running.

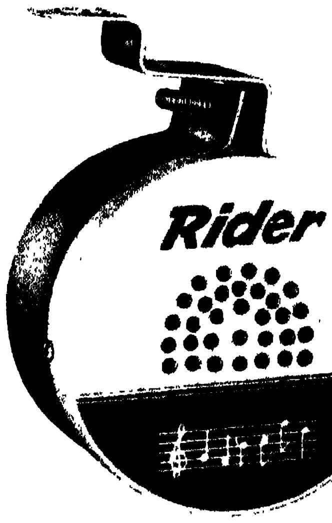
It incorporates 12.5mm high seven-segment bright LED display. It runs on 230V AC
Contact Omega Electronics, 36-Hathi Babu Ka Bagh, Jaipur 302006



DIGITAL STOP CLOCK

MUSICAL REVERSE HORN

Rider has introduced a safety device for car owners As soon as the car is placed in reverse gear, the Musical Reverse Car Horn will start playing loud musical tunes thereby attracting attention of people around This will help avoid possible bumping into a person behind the car This sturdy and waterproof musical horn operates on 12V or 6V DC and is available in single, twelve and sixteen tunes (melodies)
Contact: Powertech International, 108, Hill View Indl Estate, L.B.S. Marg, Ghatkopar, Bombay 400086

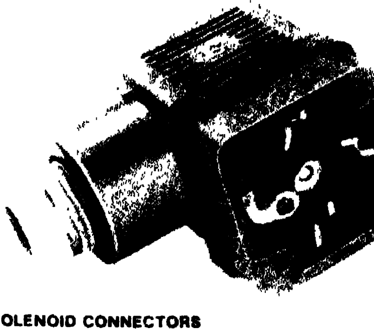


MUSICAL REVERSE HORN

SOLENOID CONNECTORS

These connectors from Elcom are made to suit DIN 43650 arrangement and are made for positive interconnection for use with solenoid valves and other equipment

The socket is complete with cable gland to suit 8-10mm diameter cables and features a



SOLENOID CONNECTORS

retaining screw and synthetic rubber gasket. Cable connection is made via screw terminals.

Contact: Elcom, 103, Jaygopal Indl Estate, B. Parulekar Marg, Dadar, Bombay 400028

ELECTRO-MESSAGE

Electro-Message from Mahendra offers a totally new concept in display of messages for advertisement, news, etc The display is based on the microprocessor-controlled LED technology The display can be changed at any moment, and as many times as required Messages can be made to flash, blink, roll around or scroll vertically.

Advertisement spots which change everyday, spot news displays which can be updated in seconds, messages to page a person in restaurants and flight announcements at airports are some of its uses.

ELECTRO-MESSAGE

The display can contain up to eight independent panels of 16 characters each, and messages up to a thousand letters can be stored at any one time Alternatively, a bit-mapped option can be provided to display figures along with characters

Contact· Mahendra Electronics, C5 Chiragh Enclave, New Delhi 110048.

DIGITAL HAND TACHOMETER

Beacon's Digital Hand Tachometer LDH-7004 is a compact, light-weight (300 gms) and easy-to-handle tachometer with a range of 0-10000 rpm and accuracy of ±1 rpm It has four-digit large-size (12.5mm height) displays of bright red colour. The memory feature memorises the last reading which can be called back any time The instrument can be supplied with an optional surface wheel for measuring linear speeds up to 1000 m/min with an accuracy of ±0.1m/min It works on four penlight cells. The battery lasts for approximately 5000 operations.

DIGITAL HAND TACHOMETER

Contact: Beacon Industrial Electronics Pvt Ltd, 13-A, Shri Ram Industrial Estate, Katrak Road, Wadala, Bombay 400031

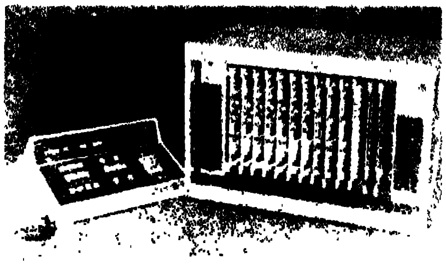
40-IN-1 ELECTRONIC PROJECT KIT

After 1 year R&D job, Electronic Hobby Centre has developed 40-IN-1 Electronic Project Kit, first time in India. This kit offer electronic education with exciting fun and games This covers the experiments of sound music disco, test circuits, timer & communication circuits etc—basic to advance The main features of this kit are no soldering, reuseable parts An Instruction Manual is provided with the kit.

Contact Electronic Hobby Centre, F 37 Nand dham Indl Estate, Marol Bombay 400059

ELECTRONIC PABX

Indian Telephone Industries Ltd (ITI) introduces the SDBX50/100 Electronic PABX using microprocessor-controlled cards providing a wide range of customer facilities It can be expanded from 50 to 100 lines with eight to 16 junctions



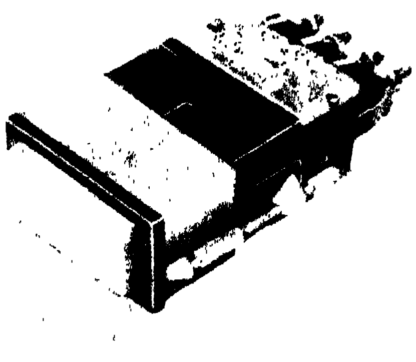
ELECTRONIC PABX

Call consult, call transfer, call forwarding don't disturb, auto call-back and three-party conference are some of its special features

Contact Indian Telephone Industries Ltd, Dooravani Nagar, Bangalore 560016

LIGHTED PUSHBUTTONS AND INDICATORS

Efficient Engineering has developed a unique and economically designed series 34 Lighted Pushbuttons and Indicators with rectangular bezel. Two independent lamp circuits and one or two pole SPDT self-cleaning and snap-acting microswitches, momentary or maintained action or any combination, offer 100 per cent redundancy and a comprehensive functional range



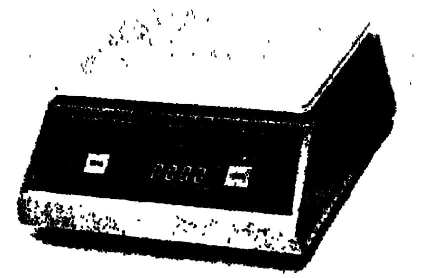
LIGHTED PUSHBUTTONS AND INDICATORS

Ideally suited to process control instrumentation, supervisory remote control systems, data acquisition and control systems, sequencing logic controls, hierarchy controls and turnkey instrumentation

Contact Sai Electronics, (A Divn of Starch & Allied Industries), Thakor Estate, Kurla-Kirol Road, Vidyavihar (West), Bombay 400086.

MINI PERSONAL BALANCE

A & D Company Ltd, Japan has introduced a new series of Mini Personal Balance This portable, yet extremely reliable balance is the first product which can withstand the most adverse environmental conditions and rough handling A sturdy, compact casing, together with overload and shock protection, makes this unit very portable specially when optional rechargeable battery is installed The balance is provided with a wide pan for easy weighing. The balance has cobalt-blue fluorescent tube with easy-to-see display and can be hooked to AD-8116 compact printer with optional interface It is available in two models, 500g with 0.1g resolution and 5000g with 1 gram resolution



MINI PERSONAL BALANCE

Contact. Universal Biochemicals, Enzyme House, 6 Sathya Sayee Nagar, Madurai 625003

AUTOMATIC DIGITAL LOOP TESTER

Thorn Emi Instruments Limited, UK has introduced its first fully Automatic Digital Loop Tester to perform earth-loop impedance tests. The tester, designated LT5, is for quick, accurate and reliable testing of wiring installations.

The LT5 requires no setting up. A test is automatically executed if a connection is made to the circuit being tested and one of two measurement ranges is selected. It is a lightweight, hand-held instrument with a large 3½-digit liquid crystal display giving direct readings down to 0.01- -

The instrument executes tests directly and measures ranges from 0-20- and 0-200- at an

AUTOMATIC DIGITAL LOOP TESTER

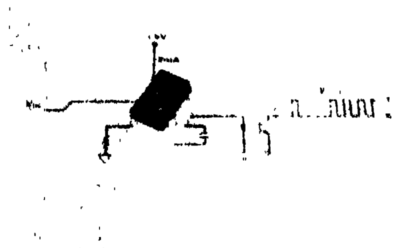
operational voltage of 200V to 260V AC rms (45Hz to 65Hz) Earth continuity and correct phase connection are indicated by neon lights and an audible signal of test execution is given It has fuse and thermal protection and is housed in a strong plastic case to withstand rough treatment A mains supply test lead, fitted with a Euro-socket and 3-pin plug (to BS 1363) is provided

Supplied as an optional extra is a dual (red black) test lead set fitted to a Euro-socket and terminated with prods. The dual lead set enables the tester to be switched on and leaves the operator's hands free to use the prods to perform other earth fault loop impedance tests These include bonded metal work and light-fitting tests, loop tests on three-phase circuits, phase-earth tests on equipment and phase neutral tests

Contact Jost's Engineering Company Limited, 60, Sir Phirozeshah Mehta Road, Bombay 400001

VOLTAGE-TO-FREQUENCY CONVERTER

A low-cost 500kHz full-scale Voltage-to-Frequency (V/F) Converter, featuring low quiescent power drain from a single 5-volt power supply, has been introduced by Analog Devices Inc., USA The AD654 monolithic converter draws 2 5 mA maximum, less than



VOLTAGE-TO-FREQUENCY CONVERTER

and operates with as few as three passive components

It operates with single or dual supplies, from +5V to +36V or from ±5V to ±18V, and guarantees maximum nonlinearity of ±0 1 and ±0 4 per cent with 250 and 500kHz full-scale operation, respectively Full-scale input ranges from 0 to 100mV to ±30V are facilitated by its low-drift input amplifier Offset adjustment is eliminated in most applications by the low maximum offset voltage of 1 mV

Suited to a variety of industrial applications such as power monitoring and motor control, temperature measurement, energy management, phase-locked loops, and isolated signal transmission.

Contact C.H. Krishnan & Associates Pvt Ltd, Kamal Theatre Building, Safdarjung Enclave, New Delhi 110029.

COMPUTER CAPACITOR

Kynmore Engineering Co Ltd, UK offers this Jensen Computer Capacitor which is a pre-aged polystyrene unit for use in computers, storage and control circuits, and other applications demanding extremely high stability, close tolerance, very high insulation resistance, low power factor, and intrinsically low noise It is available in two types (KTTE and RTTE) which are tropically sealed units of rectangular or tubular steel or brass case constructions It has a stress-relieved dielectric of high quality orientated polystyrene foil, and extended foil construction exclusively to eliminate internal contact failures and to minimise self-inductance Working voltage is up to 1000V DC and test voltage is up to 2000V DC

COMPUTER CAPACITOR

Contact. Echbee Corporation. Karner Building, 5th Floor, 38 Cawasji Patel Street, Fort, Bombay 400001.

AUTOMATIC PUMP CONTROLLER

Russo Electronics Industries has developed a Pump Controller to operate the pumps automatically The APC-I incorporates magnetic switches - a unique design feature. The advantage of this controller is that even after long and constant use, the circuit operates at the set optimum level.

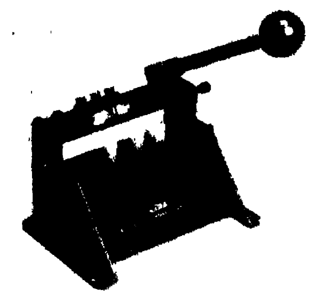
The unit has been so designed as to monitor the level of both overhead and basement tank so as to prevent the pump from dry running when there is no water in the base tank The probe for this unit is not affected by salt and other deposits

Contact: Industrial Marketing & Services, 42/1243, Nehru Nagar, Kurla (East), Bombay 400024.

JUMPER LINK TOOLING KIT

Wybar Lead Formers announces a new Jumper Link Tooling Kit for use on the Model WH-3 component lead cutting and forming machine This simple, yet versatile, hand-operated, bench-mounted machine will, with a single pull of the handle, cut and form jumper links directly from a reel of wire.

The wire is fed by hand from the reel through a hole in the cutter, then under the formers and against a wire stop With one pull of the handle, the jumper link is formed and cut off and the wire can then be guided once again to the wire stop for the next jumper link.



JUMPER LINK TOOLING KIT

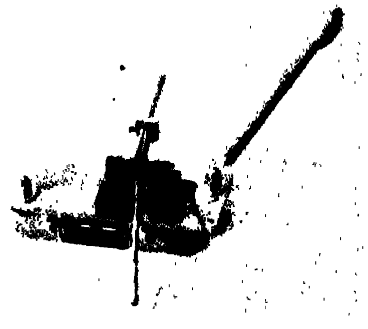
Production rates in excess of 1,000 pieces per hour are possible

Contact. Wybar Lead Formers, P.O. Box 4961, Vincent Drive, Syracuse, New York 13221.

DIE BLADE STRIPPER

Rush Wire Strippers introduces new special die blades for stripping oval and figure eight configuration wires and cables The Model RW-1 is a compact, bench-mounted, hand-operated device designed to remove the jackets from the ends of wires and cables with sizes up to 1 5 cm outside diameter. The unit utilises two accurately machined die blades to quickly and easily strip the insulation from round solid, stranded or multicore cables.

The special die blades are custom-designed to fit around oval or figure eight shaped wires and cables, to allow quick and easy stripping of the jackets. There is no risk of damage to inner conductors as occurs when using round die blades to strip these irregular cables.



DIE BLADE STRIPPER

Contact: Rush Wire Strippers (A Division of Eraser) P.O. Box 4961, Townline Road, Syracuse, New York 13221.

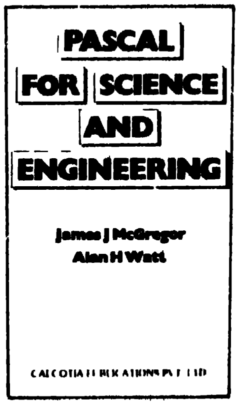
Book Reviews

Advanced Techniques in dBASE III

By Alan Simpson; published by B.P.B. Publications, Delhi by arrangement with Sybex Inc., USA; pages 505 (18 cm × 23 cm); hard cover; price: Rs 150.

This book is obviously meant for those who want to go beyond the dBASE III manual It offers programming techniques for the development of customised software As familiarity with the basic commands used in either dBASE II or III is the only prerequisite, even computer operators using dBASE III can learn programming with the help of this book It provides step-by-step explanation of the techniques used in each program After discussing the general programming considerations, the author moves on to a customised 'management system design From there he proceeds to inventory and 'accounts receivable systems designing These are followed by several handy programs and tips for solving some tricky problems It also includes some very useful appendices This book should be in the library of every establishment using an IBM PC compatible system

—R C

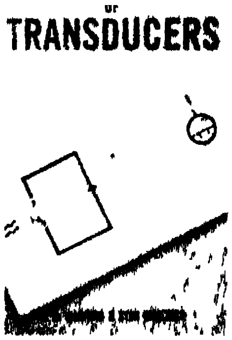


Pascal for Science and Engineering

By James J. McGregor and Alan H. Watt; published by Galgotia Publications Pvt Ltd, New Delhi; pages 348 (15 cm × 23 cm); hard cover; price: Rs 150.

Pascal is an important language for scientific and engineering applications Written in two parts, this book is excellent for self-study The beginning chapters provide an introduction to Pascal in a very simple language The latter part deals with the application of this computer language Pascal is preferred by engineers and scientists because of ease in its readability It also offers some other advantages over BASIC and FORTRAN The book is full of examples in programming In fact, the very first chapter begins with a program for calculating area and perimeter of a rectangle The book has been composed using an electronic typewriter (and perhaps a computer as a wordprocessor) but it includes a sufficient number of neatly drawn illustrations to explain the text A plotter has been used to draw the illustrations for the chapter on graphics

—R C

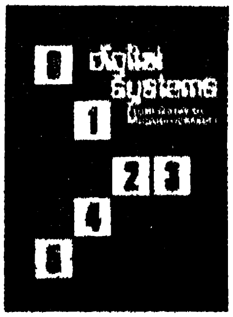


Fundamentals of Transducers

By R.H. Warring and Stan Gibilisco; published by TAB Books Inc., USA; pages 362 (13 cm × 21 cm); soft cover; price: US $ 14.95.

Transducers are devices to convert one form of energy into another Just as there are several forms of energy, there are also a variety of transducers available, with even more diverse applications. This book collates some useful information on this device, covering virtually all types of transducers and sensors. Divided into 30 chapters, this book emphasises the practical techniques rather than mere theory While design characteristics and applications are discussed in detail, related circuitry and its design are also included Circuit schematics give the experimenter hands-on experience, applying the concepts discussed Some practical projects are also suggested The book should prove invaluable as a workbench reference for theory and practice of transducer technology

—R B.

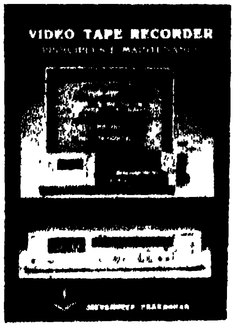


Digital Systems From Gates to Microprocessors

By Sanjay K. Bose; published by Wiley Eastern Ltd, New Delhi; pages 424 (18 cm × 24 cm): soft cover; price: Rs 45.

This book aims at students who wish to familiarise themselves with digital systems—from basic concepts of Boolean algebra and digital circuit design using gates and flip-flops to the fundamentals of microprocessors and microcomputer systems The initial chapters (1 to 5) introduce the subject while chapters 6 to 12 detail the operation of various common LSI integrated circuits The book also discusses CPU architecture, microcomputer organisation, I/O techniques, interrupts and analogue interfacing Popular Intel 8085A and Zilog Z80 microprocessors are dealt with in detail Some single-chip microcomputers are discussed in a separate chapter (13) The last chapter (15) acquaints the reader with the aids available in designing and developing microprocessor based systems Essentially aimed at students of digital systems, this book provides a thorough grounding in the subject in a simple and lucid language

—R.B.



Video Tape Recorder, Principles and Maintenance

By M.M. Malik; published by Jeevandeep Prakashan, Bombay; pages 186 (29 cm × 22 cm); hard cover; price: Rs 200.

Until yesterday, colour television was the status symbol in Indian market But now its place has been taken by video tape recorders. VTRs have flooded the Indian markets and their strength is likely to grow steadily in the coming years Here is a publication that deals both with theoretical and practical aspects of video playback and recording techniques and their troubleshooting methods. The first chapter sets down the story of VTRs, their recording systems and their improvements with time The second chapter provides all the practical aspects of the principles of video tape recorders.

Chapter three deals with the general outlines of VHS machines, magnetic tape pattern, colour and luminance signal playback/recording system, audio signal recording system and the construction of a VHS cassette In chapter four, the author expounds practical aspects of video recorder maintenance and troubleshooting methods. The author also provides circuit diagrams of luminance/crominance playback and recording sections, servo section, power supply regulator, audio, timer, antenna booster, demodulator and RF converter for Akai VCR models VSP1, VS9700, VS2EG, VS5EG and portable VP86 EG in the same chapter.

Chapter five is devoted to the microprocessor based systems incorporated in modern VTRs for character function, key scanning, search operation etc. This book has been written for millions of buyers as well as technicians who wish to familiarise themselves with various kinds of video systems and their maintenance and troubleshooting

—D G.

39 One-Evening Electronic Projects

By Robert J. Traister; published by TAB Books Inc., USA; pages 182 (21 cm × 13 cm); soft cover; price: US $ 9.95.

In these modern times, it is sometimes quite difficult to find a source of entertainment that is rather simplistic, challenging and can be accomplished in relatively short periods. This is especially true about the realm of hobby electronics Here is an ideal project guide for busy hobbyists who are looking for useful projects that they can finish in a single evening Some projects are included just because they are fun to build and operate Readers will take just an hour or so to complete many of the projects. This book also contains information on how to begin assembling, proper soldering techniques, etc A list of common colour code, to make the project-building easier, is also given in this book. Projects designed to be constructed at home cost hundreds of rupees But one need not spend a lot of money to obtain components for these projects as all components were chosen with attention to low cost and universal availability. The projects will provide many evenings of unexcelled enjoyment.

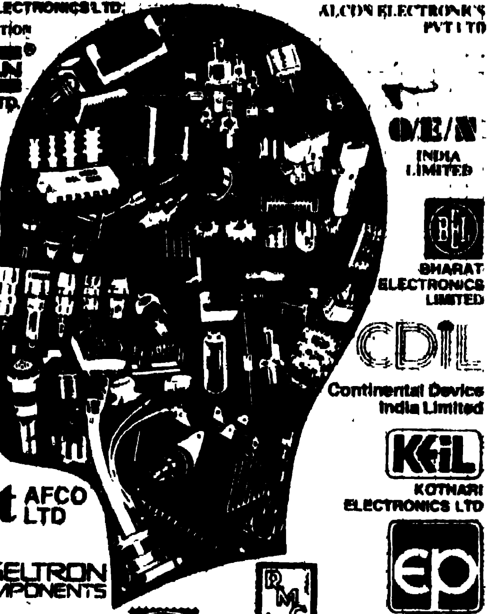
R G

Electronic Weighing Systems

By C.S. Rangam; published by A.H. Wheeler & Co. (P) Ltd, Allahabad; pages 48 (24 cm × 18 cm); soft cover.

The need for weighing devices has always been there, particularly since 5000 BC. However, there has been a marked improvement in accuracy and reliability with sophistication due to advancement in the field of electronics and other related fields. This book presents the state-of-art in the field of electronic weighing systems, including practical information and operating principles of a variety of weighing systems. The book is divided into six chapters. Chapter three deals with the study of basic electrical load cell devices for various ranges. While in chapter two and four a detailed study and discussion on the mechanical, conventional and electronic weighing systems is given. Chapter six discusses the calibration and standardisation of weighing systems. Chapter five deals with the various applications of these systems.

—R.G.



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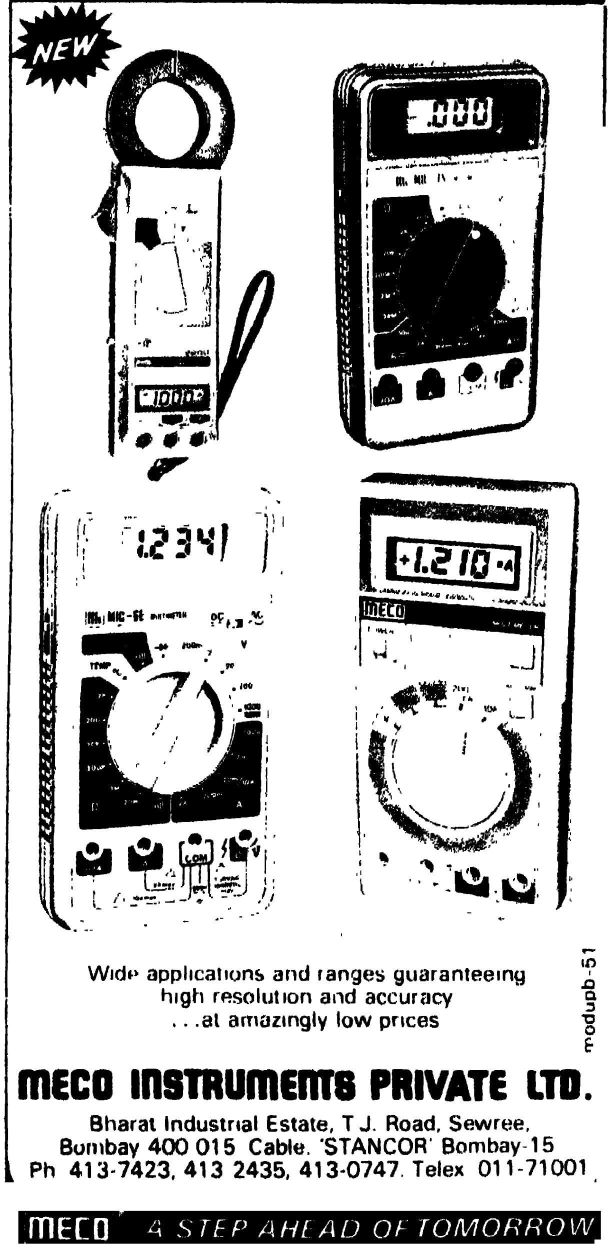

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Company Profiles

Meltron to make computer peripherals

The Maharashtra Electronics Corporation Limited (Meltron), a government of Maharashtra undertaking, would be adding several new technology product lines to its existing range of products in the area of computer peripherals and communication during the year 1986-87.

Meltron has been engaged in the production of audio-visual equipment, radio communication equipment, personal computers, EPABX etc. In addition to its own manufacturing units, Meltron is engaged in the marketing of products manufactured by small-scale units.

It has achieved a turnover of more than Rs 82 million for the year ended March 31, 1986. The major contribution towards this record turnover comes from its own manufacturing divisions at Andheri and Nagpur. For a rapid and balanced growth of electronics in Maharashtra, Meltron has set up units in widely dispersed regions like Nagpur, Kudal, Aurangabad and Nasik, in addition to playing an active role for setting up electronic estates in different parts of the state.

Siemens text and data network for India

Overcoming stiff international competition, Siemens has bagged a new order for further expansion of its text and data network in India.

The order includes EDX electronic switching systems with sufficient capacity for the connection of approximately 10,000 new telex users in six cities. The delivery is expected to start this year. Including the exchanges already in operation in Bombay, Calcutta, Delhi and Madras, this will mean that India—with around 32,000 connected users—will have the largest EDX text and data network in the world.

In the process of modernising its telex network, the government has already invested over Rs 250 million. Any future extension of this network will make provision not only for services already available, such as abbreviated dialling and direct dialling, but also for teletext and high-speed data transmission. The EDX exchanges now in use, being flexible and capable of expansion at an economic price, are eminently suitable for this purpose.

K.L. Industries signs agreement with Tsubame

K.L. Industries Ltd, Kanpur, signed an agreement with Tsubame Radio Co. Ltd, Japan on April 3, 1986, for the transfer of technical knowhow in the manufacture of a wide variety of carbon track potentiometers in India. Potentiometers are important electronic components extensively used in TVs, VCRs, radios, tape recorders, amplifiers and various other applications.

The estimated cost of the project will be Rs 15.9 million and the plant will have an annual production capacity of 12.6 million pieces. It will be located at Fatehpur, UP. Most of the equipment will be imported from Japan, and the screen-printing technology for the manufacture of the carbon track will be used for the first time in India. The plant is expected to go into commercial production by February, 1987.

Anjaleem to enter telecom field

Anjaleem Enterprise & Consultants, set up eight months ago to export computer software, is expected to venture into the Indian telecommunications market shortly.

The company's 100-per cent software export unit at Baroda has chalked up significant earnings of over Rs 2.5 million since setting up its complete infrastructure last year. Anjaleem has also signed a contract with an US company in the field of telecom switching software.

Shilpa International to represent Protex

Shilpa International, Secunderabad has been appointed as the representative of Protex, a French company, in India for all the Protavic (a subsidiary of Protex) products meant for the electronics and electrical industries.

Protavic is a 100-per cent French-owned company with a factory and R&D laboratory at Auzouer en Touraine, France. The company is dedicated to the creation, development and manufacture of chemicals, special fabrications and materials for advanced technology industries, such as professional and public electronics, aeronautics, space telecommunication, industrial electrotechnique, industrial electricity, etc.

The various products manufactured by Protavic include conductive resins, specific diluents for non-polymerised resins and insulation resins for casting encapsulation.

Forward Electronics to enter market

Forward Electronics and Leasing has entered the capital market with an issue of 700,000 equity shares of Rs 10 each for cash at par to augment its working capital resources.

The company was incorporated in 1984 with the object of offering a package of services to the industrial, business and professional clients in the area of leasing, hire-purchase and financial consultancy. It is also engaged in marketing and distributing consumer durables with an accent on computers, television sets and other electronic items.

The company has already negotiated lease tie-ups with such reputed companies like Nirlon Synthetics, Hindustan Construction, Greaves Foseco and the National Radio and Electronics Company.

The company expects a turnover of Rs 40 million for the year ending June 1987, yielding a net profit of Rs 4.5 to 5 million

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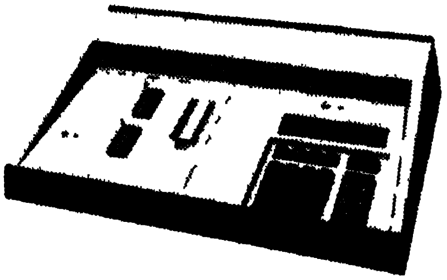

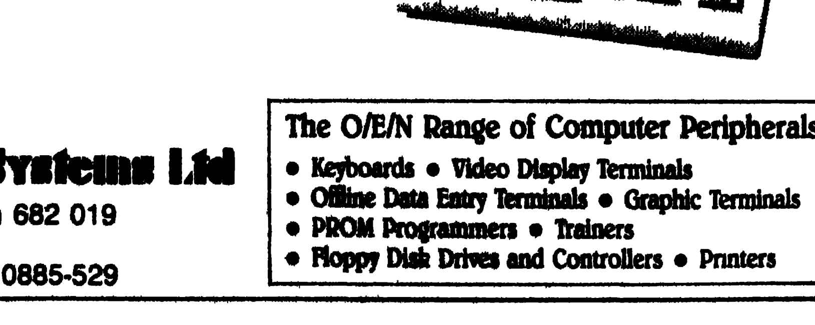

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FOREIGN COLLABORATIONS

Approved between October and December, 1985

Name & Address of the Indian Firm (1)	*Name & Address of the Foreign Firm* (2)	*Item of Manufacture (Nature of Collaboration)* (3)
Great Worth Electric Engineering Co Pvt Ltd Bangalore	Rod Medzintechnik Electronic Ing Hans Rodler Pehamweg Austria	Electronic instruments (Technical)
Ambalal Sarabhai Enterprises Ltd Baroda	Dansk Data Electronic Denmark	Minicomputers/micro processors based systems (Designs and drawings)
Gujarat Communication and Electronics Ltd Baroda	Siemens Aktiengesell shaft West Germany	Electronic pushbutton telephones (Technical)
Kerala State Electronics Dev Corpn Ltd Keltron House Vellayambalam Trivandrum 695001	Siemens Aktiengesell shaft West Germany	Electronic pushbutton telephones (Technical)
Kienzle Indian Samay Ltd 14 A 31 WEA Karol Bagh New Delhi 110005	Kienzle Unrenfabriken West Germany	Quartz timing movements (Financial)
P K Agrwal Haryana Telecommunication Ltd New Delhi	Siemens Aktiengesell shaft West Germany	Electronic pushbutton telephones (Technical)
Prestige Counting Instruments Pvt Ltd Khelan Bhavan 198 Jamshedji Tata Road Bombay 400020	Samson A G MESS Und Regeltechnik Weismuller Strasse 3 Post Box 4147 D-6000 Frankfurt am main 1 West Germany	Self operated tempera ture controllers (Designs and drawings)
Punjab State Indl Dev Corpn Ltd Chandigarh	Triumph Adler Aktiengesellschaft West Germany	Electronic typewriters (Technical)
Ranjit Electronics 502 Hemkunt Tower New Delhi 110019	Siemens Aktiengesell shaft West Germany	Electronic pushbutton telephones (Technical)
Telematics Systems Ltd Madras	Siemens Aktiengesell shaft West Germany	Electronic pushbutton telephones (Technical)
United Diamond Ltd Chandigarh	Blaupunkt Werke GmbH West Germany	Flyback transformers (Technical)
West Bengal Electronics Indl Dev Corpn Ltd Calcutta	Siemens Aktiengesell shaft West Germany	Electronic pushbutton telephones (Technical)
Bhartia Culter Hemmer Ltd Calcutta	Syrelec France	Electronic industrial control relays and devices (Technical)
Blue Star Ltd Bombay	Jeumont Schneider France	EPABX/EPAX and allied equipment (Technical)
Escorts Ltd New Delhi	Jeumont Schneider France	EPABX/EPAX and allied equipment (Technical)
Indian Telephone Industries Ltd Bangalore	Jeumont Schneider France	EPABX/EPAX and allied equipment (Technical)
Larsen & Toubro Ltd Bombay	Jeumont Schneider France	EPABX/EPAX and allied equipment (Technical)
Mekaster Consultants Pvt Ltd New Delhi	Telic Alcatel France	Video telex/teleprinters (Technical)
The Aluminium Industries Ltd Kundra	Mors Relais Et Automoates TECM France	Auxillary and Electronic Relays (Technical)
UP Electronic Corpn Ltd Lucknow	Jeumont Schneider France	EPABX/EPAX and allied equipment (Technical)
Usha Computer & Peripherals Ltd New Delhi	Jeumont Schneider France	EPABX/EPAX and allied equipment (Technical)
West Bengal Electronics Indl Dev Corpn Ltd Calcutta	Jeumont Schneider France	EPABX/EPAX and allied equipment (Technical)
Pegasus Prima Products (India) Ltd Bombay	Robotron Export Import GDR	Electronic Typewriters (Technical)
Garware Plastics & Polyester Ltd Bombay	Magnatech Ltd Hongkong	Floppy discs (Technical)
Usha Martin Industries Ltd 14 Princep Street Calcutta 700072	De Angeli Industries Italy	Telephone cable machinery and power cable machinery (Technical)
Hindustan Conductors Pvt Ltd Bombay	Nippon Semicon Co Ltd Japan	Diffused rectifier diode wafers (Designs and drawings)
Indian Telephone Industries Ltd Bangalore	Japan Radio Co Japan	Digital UHF radio relay systems (Technical)
J K B M Ltd Calcutta	Oki Electric Industries Ltd Japan	EPAX/EPABX and allied equipment (Technical)
Mahindra & Mahindra Ltd Bombay	Oki Electric Industries Ltd Japan	EPAX/EPABX and allied equipment (Technical)
Murphy India Ltd New Delhi	Ricoh Co Ltd Japan	Plain paper copiers (Technical)
Orien Engineers Pvt Ltd Orissa	Nitto Kohki Co Ltd Japan	Solar collector panels and accessories (Technical)
Superphone India Ltd Bombay	Oki Electric Industries Ltd Japan	EPAX/EPABX and allied equipment (Technical)
Swadeshi Polytex Ltd Ghaziabad	Tokyo Ferrite Manu facturing Co Japan	Hard ferrites (Technical)
UP Electronics Corpn Ltd Lucknow	Toshiba Corpn and Mitsubishi Corpn Japan	CTV picture tubes (Financial)
Karnataka State Electronics Dev Corpn Ltd Bangalore	Ericsson Information Systems Sweden	Electronic pushbutton telephones (Technical)
Nitin Goel C II 22 Tilak Marg New Delhi	Ericsson Information Systems Sweden	Electronic pushbutton telephones (Technical)
Orissa State Electronics Dev Corpn Ltd Bhubaneshwar	Ericsson Information Systems Sweden	Electronic pushbutton telephones (Technical)
Punjab Wireless Systems Ltd B 53 Phase VI SAS Nagar Chandigarh 160055	Ericsson Information Systems Sweden	Telephone Instruments (Technical)
Rajasthan State Indl Dev Corpn Ltd Jaipur	Ericsson Information Systems Sweden	Electronic pushbutton telephones (Technical)
Shree Jaisal Chemicals Ltd Jaipur	Ericsson Information Systems Sweden	Electronic pushbutton telephones (Technical)
The Purtabpore Co Ltd Calcutta	Ericas Ericsson Information System Ab Sweden	Components for telephone instruments (Technical)

Name & Address of the Indian Firm (1)	Name & Address of the Foreign Firm (2)	Item of Manufacture (Nature of Collaboration) (3)
United Telecoms Pvt Ltd Madras	Ericsson Information Systems Sweden	Electronic pushbutton telephones (Technical)
Bharat Heavy Electricals Ltd New Delhi	BBC Brown Boveri & Co. Ltd Switzerland	Programmable controls (Technical)
Debikay Electronics Industries Pvt Ltd Calcutta	Holderbank Management & Consulting Ltd Switzerland	Control systems for cement plants (Designs and drawings)
Auto Measurematic Ltd 46-47 Developed plots for electrical and electronics industries perngudi Madras 600096	Matherwell Control Systems Ltd UK	Electronic beltweighing equipment (Technical)
Gold Relays & Electronics 162/B/203 Lake Gardens 24 Paraganas West Bengal	P and B Engg Co England	Protective relays (Technical)
Kerala State Electronics Dev Corpn Ltd Keltron House, Vellayambalam Trivandrum 695033	Brown Boveri Kent, PLC UK	Digital distributed process control systems (Technical)
Pilot Engines Pvt Ltd G-17 Vysarpadi Co-op. Indl Estate Madras 600039	Electronic Autosizing Metrology UK	Electronic Autosizing and Gauging Equipment (Technical)
Punjab Wireless Systems Ltd B-53, Phase VI SAS Nagar Chandigarh 160055	Rediffusion Radio Systems Ltd UK	Non-directional MF beacon transmitters (Designs and drawings)
Tata Bradbury Wilkinson Pvt Ltd Bombay House Bombay 400023	Bradbury Wilkinson Ltd UK	Magnetically encoded machine readable cheques and drafts (Financial)
The General Electric Co. of India Ltd Calcutta	Radyue Ltd UK	Static inverter generator value indication generators (Technical)
Western India Erectors Ltd Sahyadri Sadan Tilak Road Pune 411030	PED Ltd Switch & Display Divn Exning Road, Newmarket, Suffolk CB 8 OAX UK	Membrane switches and key boards (Designs and drawings)
A.B Controls Ltd C-11, Site IV Industrial Area Sahibabad, Ghaziabad	Exide Electronics Corpn USA	Uninterruptible power supply systems (Technical)
Apurba Mukherjee F/1D Selimpur Road Calcutta 700031	Star Macro Inc. USA	Monitors, process sensors and process control equipment (Financial)
Bells Control Ltd Bells House 21, Camac Street Calcutta 700016	The Foxboro Company USA	Process management and control systems (Technical)
Bharat Heavy Electricals Ltd 18-20 Kasturba Gandhi Marg New Delhi 110001	General Electric USA	Variable speed AC drive (Technical)
Chuck Materials Pvt Ltd 31, Jor Bagh New Delhi 110003	Minsk Machinery Corpn USA	Flexible magnetic media (Floppy discs) (Technical)
Contech India Pvt Ltd Ashokwadi, Panchvari Ellisbridge Ahmedabad 380006	Integrated Systems Inc. USA	Microprocessor based energy controls (Technical)
EG & G Vactec Opto Electronics 10900 Page Boulevard St. Louis Missouri 63132 USA	EG & G Vactec USA	Infra-red retroflective switches etc (Financial)
Emar Electronics (I) Ltd P.O. Koderma Bihar	Acushnet Capacitor Co. USA	Mica capacitors (Technical)
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Gujarat Communications & Electronics Ltd Baroda	M/A-COM DCO Inc. USA	Digital single channel per carrier (SCPC) (Designs and drawings)
Infotech Ltd Madras	Stride Micro USA	Microcomputer systems (Technical)
Mahesh M Uberoi 112, Burnham Road Morris Plains, NJ-7950 USA	Oberoi International Inc. USA	Software in the Santacruz Electronics Zone (SEEPZ) (Financial)
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Omni India Ltd 189, Golf Links New Delhi 110003	Omni Resources Corpn USA	Floppy discs (Technical)
Pasadena Technology India Pvt Ltd 10 Jawahar Road Chokkikulan Madurai 625002	Electronic modular systems Inc., Texas USA	Electronic connectors (Financial)
Pasadena Computer Software Pvt Ltd 32, Brindavan, 4th Cross Street Madras 600028	Electronic modular systems Inc USA	Computer software (Financial)
The National Radio & Electronics Co. Ltd Mahakali Road, Chakala Andheri (East) Bombay 400093	General Electric Technical Service Co Inc 1 River Road Bldg 513W Schenecady New York 12345, USA	Thyristor controlled devices (Designs and drawings)
Kerala State Indl Dev. Corpn Trivandrum	Ishara Commerce Yugoslavia	Ferrite magnets (Technical)
Artel Communications Pvt Ltd Viraj, 3rd Floor Near H.K. House Ashram Road Ahmedabad 380009	Jeumont Schneider France	EPABX/EPAX and allied equipment (Technical)
Chaman Mahajan A-58 Vasant Vihar New Delhi 110057	Yamatake Honeywell Japan	Process control instrumentation etc (Financial)
Abhaya Kashyap 7 Dr Bishambar Das Marg New Delhi 110001	Dr Yousif S.F. Al Sabah Kuwait	Computer software (Financial)
Bipin Kumar Agarwal 3003 Skypark Houston, Texas USA	Osborne Computer USA	Minicomputer microprocessor based systems (Technical)
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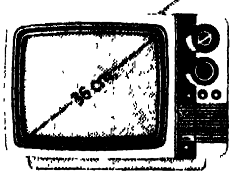

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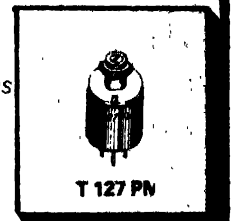

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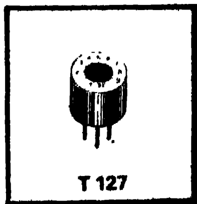

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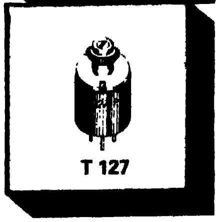

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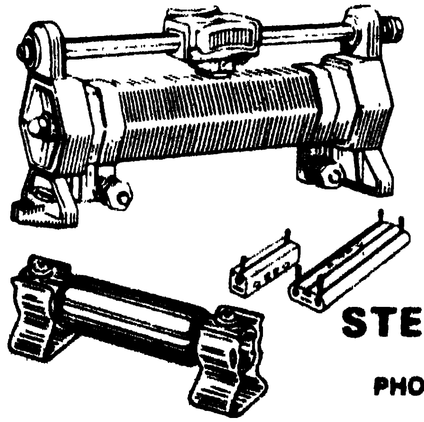

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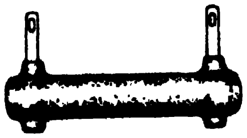

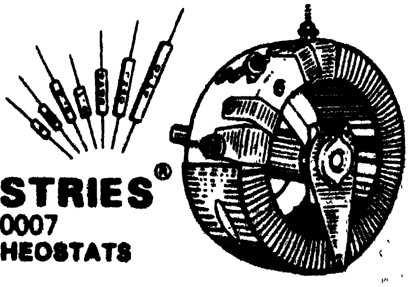

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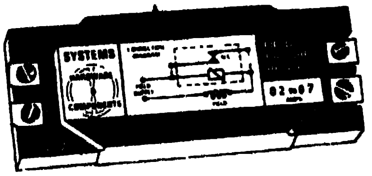

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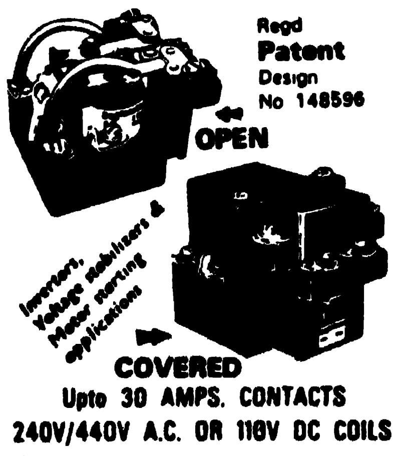
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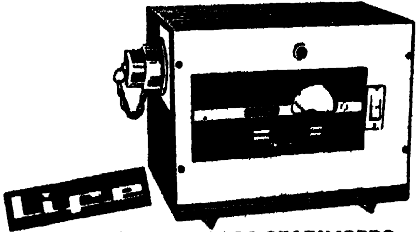

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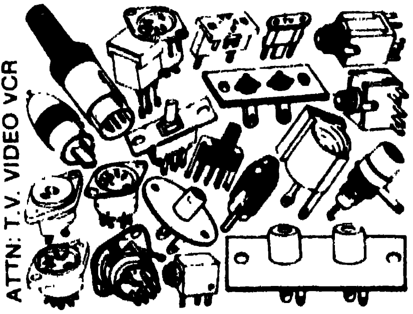

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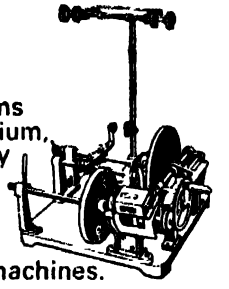

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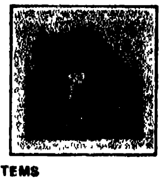

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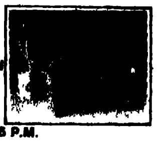

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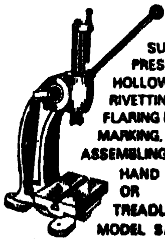

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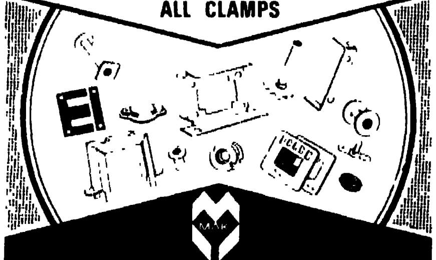

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Advertisers' Index

ABR Electronics	50
ASE Ltd (Systronics)	92
Al Plastics	53
Alfa Products	84
Allied Publishers	54
Amar Radio Corporation	105
Ankur Services	65
Arun Electronics	94
Asia Electric	8
Associated Electrical Agencies	7
B P B. Publications	10
BPL-India	91
Bajaj Electricals	39
Balaji Engineering	32
Brisk Electro Sales	76
B+K Engineers	66
CTR Manufacturing	52
Champion Electronics	67
Component Technique	76
Control Signals	45
Crescent Agencies	85
Cycl-O Computers	54
Devices & Control Systems	29
Diana Television	20
Dominion Radios	30, 54
Echbee Corporation	46
Elcompo	22
Electrical Equipment Corpn	45
Electronic Instruments & Controls	8
Electronics Corporation of Tamil Nadu	60
Elnova	21
Essen Deinki	86
Fluxall Industries	20
Geeta Monitors	30
Hindustan Brown Boveri	5
ITT, West Germany	IV Cover
Inde Associates	9, 12
Indian Engineering	97
J J Electronics	54
J R. Controls	84
Jetking Electronics	105
Karnataka State Electronics	31
Konark Television	II Cover
Krishnonics	6
Kusum Sales	84
Kwality Electricals	90
Labgear India	30
Lakshmi Electrical	40
Leader, Japan	41
Leader Electronics	92
Meco Instruments	105
Micronaids	8
Motwane Manufacturing	42
Murugappa Electronics	15
Neotronics International	77
Nippon Denshi	90
Novoflex Cable Care	93
O/E/N Micro Systems	107
Perfect Electronics	98
Plastart	32
Professional Electronics, Delhi	90
Rajasthan Electronics	14
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Small Industry Research	23
Stovec Screens	83
Texonic Instruments	84
Time Engineers	94
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Videoton, RT	75
Virgo Electronic	44
Vishal Agencies	50
Webel Sen Capacitors	59

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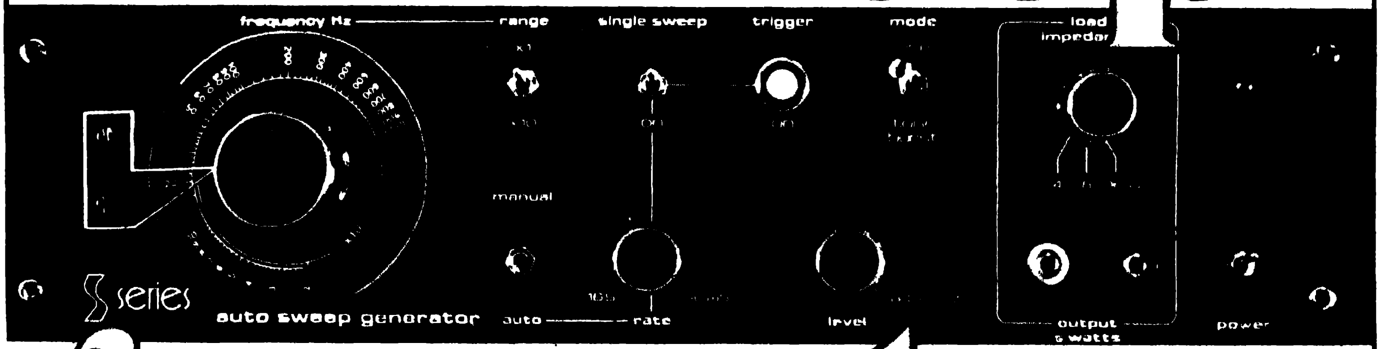

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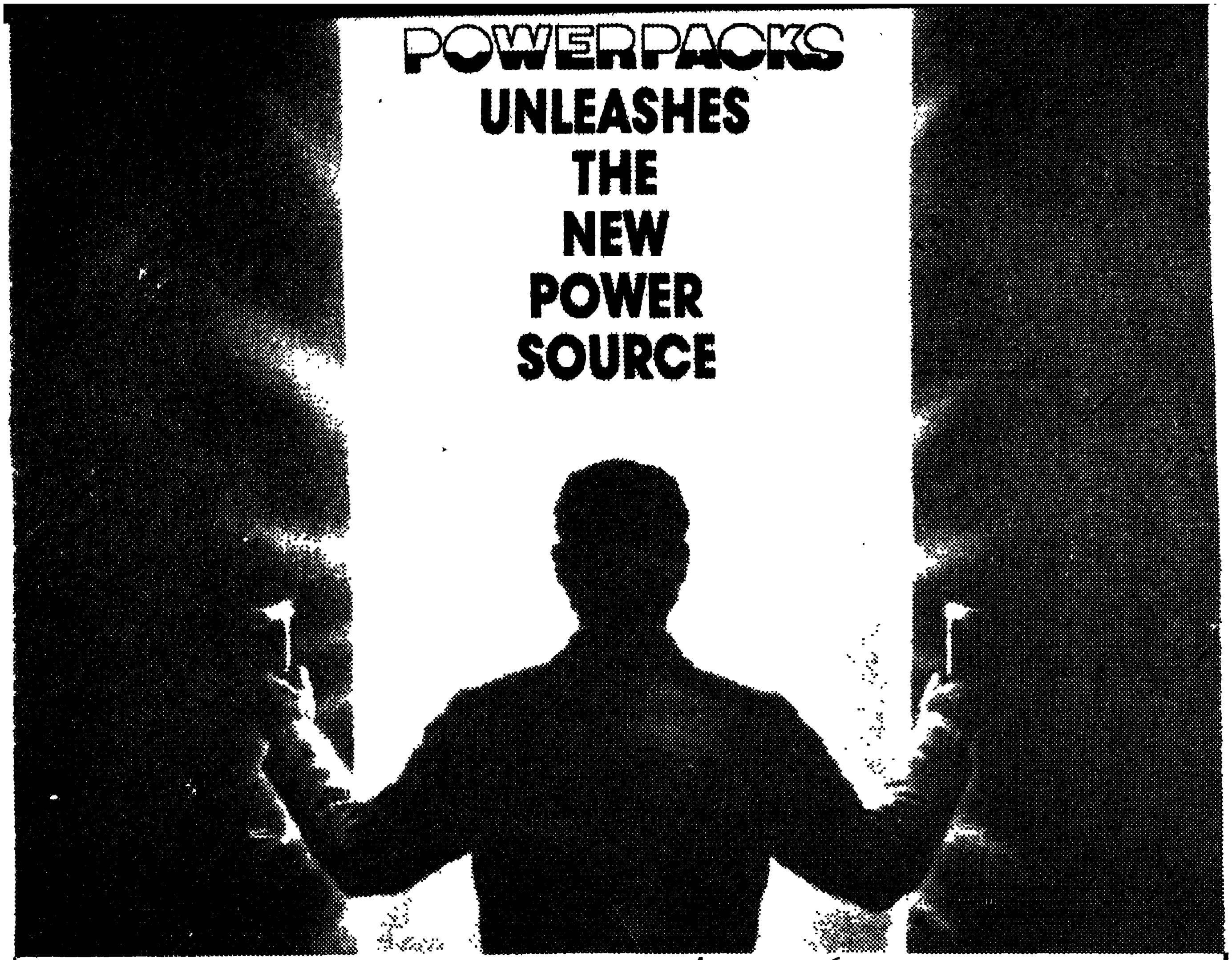

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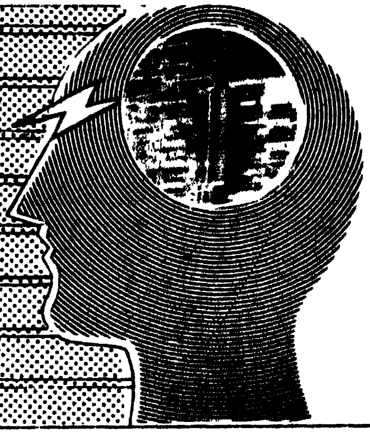

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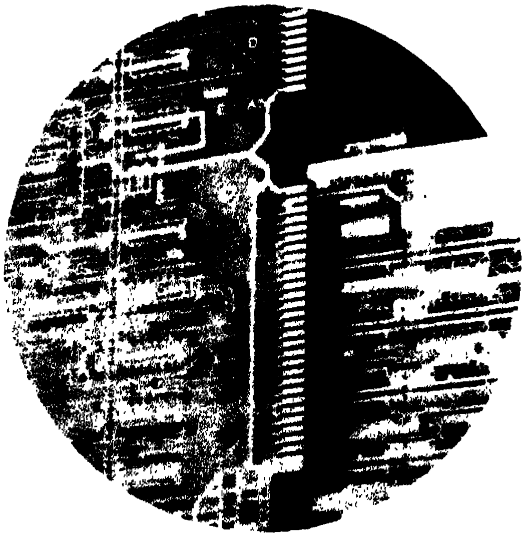

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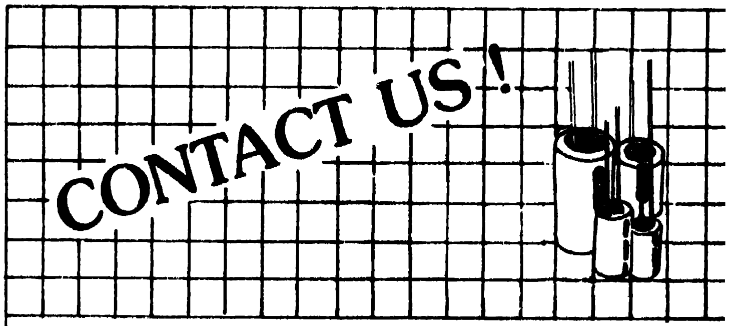

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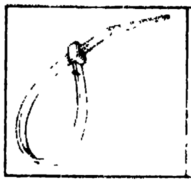

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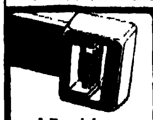

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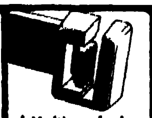

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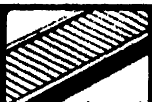

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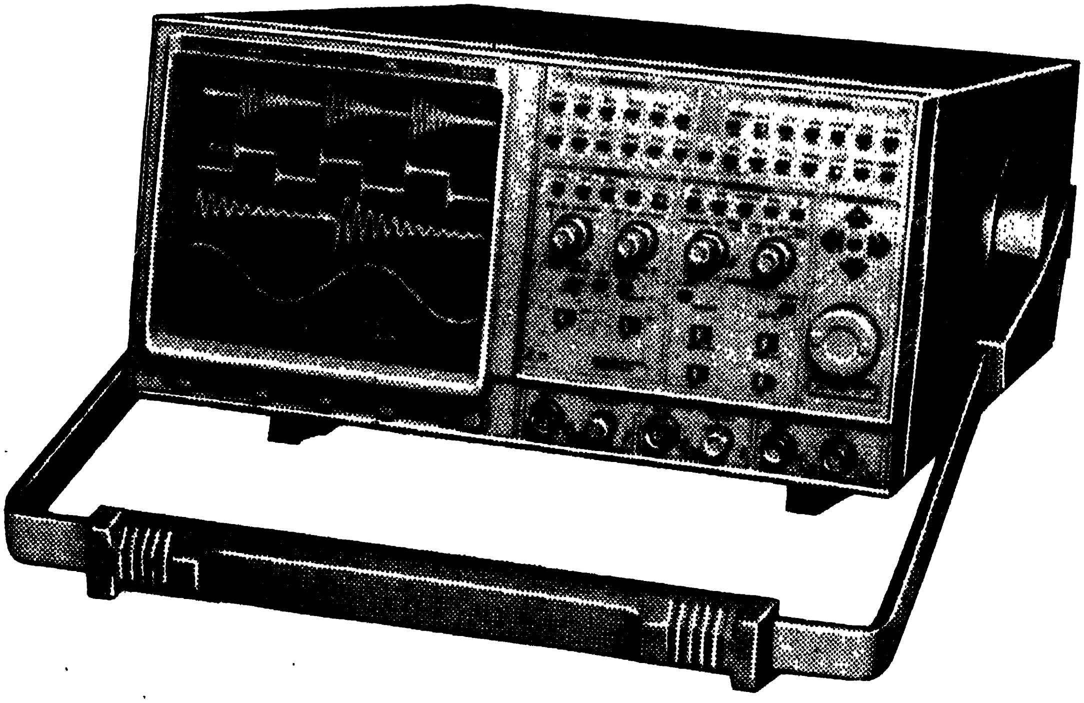

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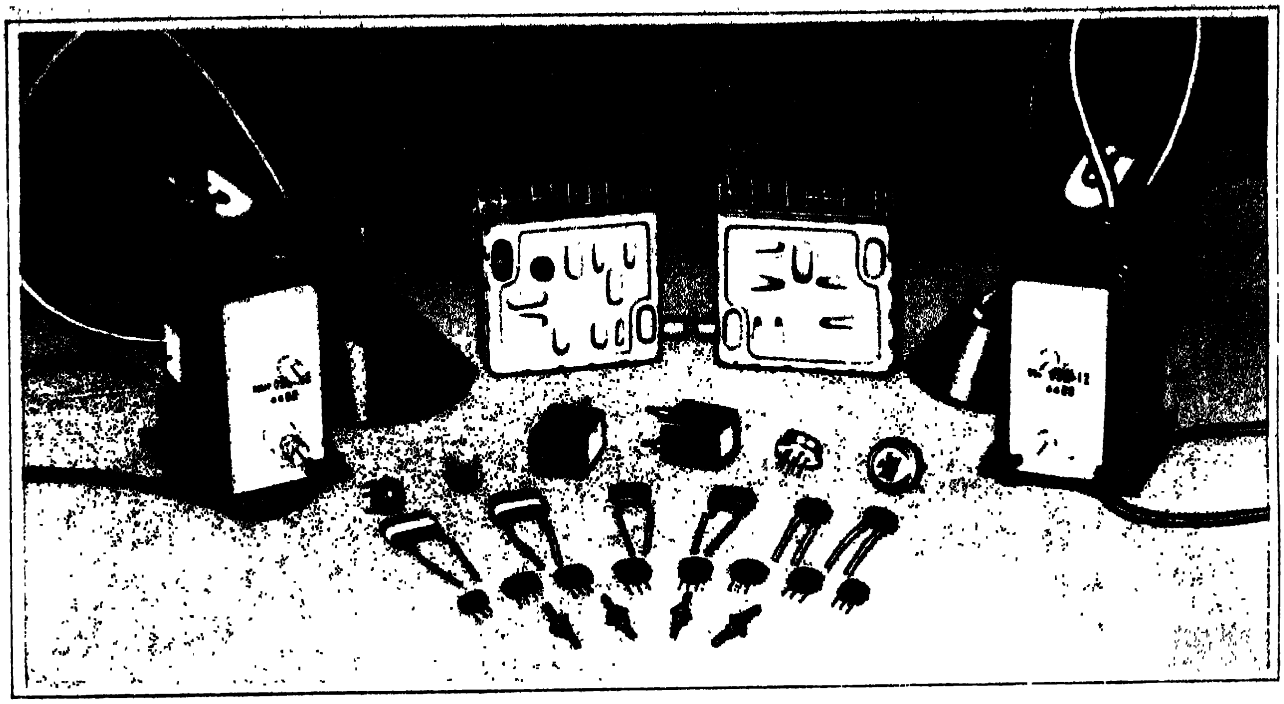

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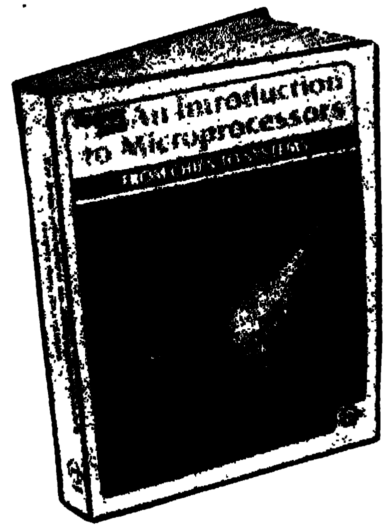

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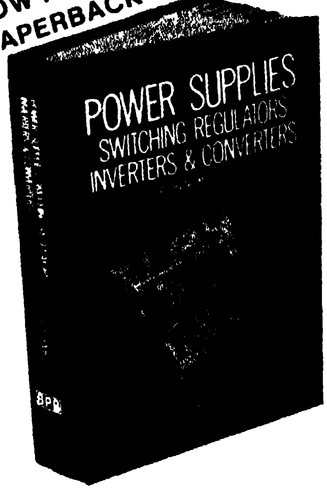

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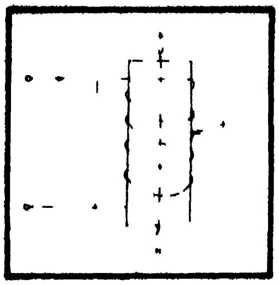
Magnetisers and Magnetising Fixtures



21 The process of magnetisation essentially requires two parts—magnetisers and magnetising fixtures. This article describes various types of magnetisers and their principles of operation. Some design considerations and practical guidelines for magnetising fixtures are also discussed

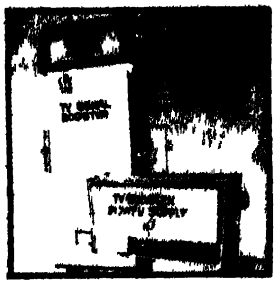
—*P.D Joshi*

Computer Aided Testing

49 Computer aided testing or CAT is now being given more importance since it enhances the process of testing—an essential part of R&D, production, operation and maintenance. Speed, endurance and accuracy are the watchwords of CAT. This article briefly explains some fundamental aspects of this process

—*R Radhakrishna Warrier*

VHF TV Booster



69 The TV signal booster project given here uses the BF200B transistors recently developed by BEL. These devices have a higher gain and a transition frequency of more than 800 MHz. Hobbyists living in the fringe areas and TV DXers will particularly welcome this project

—*BEL News*

21 Magnetisers and Magnetising Fixtures —*P.D Joshi*
26 Know Thy TV —*P.K Subramanyam*
32 Characteristics of Fixed Satellite Service, Part II —*Based on an ITU Report*
38 Behind the Portable Power Sources Part II —*A V Jacob*
49 Computer Aided Testing —*R. Radhakrishna Warrier*
57 Stopwatch Cum Real-Time Clock Using Sinclair Spectrum —*Ashok Baijal*
61 Comparative Study of Computer Languages. Part XII —*R. Ramaswamy*
69 VHF TV Booster —*BEL News*
77 Stereo Control Cum Preamplifier for 120W + 120W Amplifier —*S. Das Gupta*

FEATURES

13 Letters
17 What's New
45 Computer Corner
58 Electroons
69, 77 Construction
84 Circuit Ideas
89 Product Profiles
95 Company Profiles
97 Book Reviews
98 Facts & Figures
103 Electronics Mart

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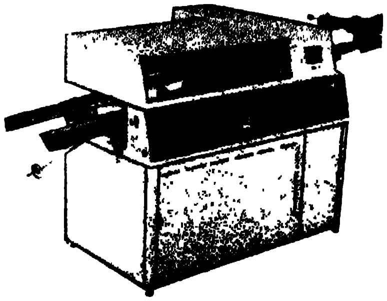

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KAVERI

Designing TTL Circuits—An Appeal

Here is an appeal to all EFY contributors designing with TTL digital ICs. Personally I feel that several TTL circuits appearing in EFY violate technical considerations in one way or the other. Some of the simple guidelines given here could help EFY readers design TTL circuits faultlessly.

Supply voltage. TTL ICs are specifically designed for operation at 5V ±5 per cent. However, I am shocked to find TTL circuits appearing in EFY time and again with supply voltages ranging from 3V to 6V. In no other magazine of international standards have I seen such blatant carelessness. After all, the 5V ±5 per cent supply could easily be obtained through a 7805 regulator chip or a 5.6V, 5 per cent zener diode with a series-pass transistor.

Driving LEDs. Very often, a need arises for driving LEDs from the output of a TTL IC. A TTL output could sink a current of 16 mA and could thus be used to drive an LED directly as shown in Fig. 1.

FIG. 1

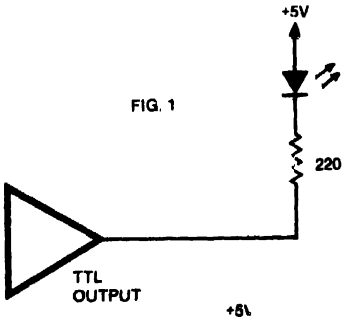
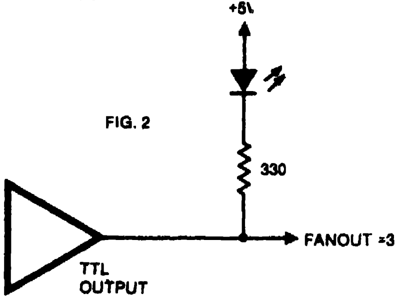


FIG. 2



The arrangement of Fig. 2 could drive an LED as well as three TTL inputs (fanout = 3). The 220-ohm resistor has been increased to 330-ohm to keep the output sink current below 16 mA.

In certain circumstances, it might be necessary for an LED to glow whenever the TTL output goes high. However, since the sourcing capability of a TTL output is very small (0.4 mA), an additional pull-up resistor should be connected as shown in Fig. 3. The value of the pull-up resistor should be greater than 5V/16 mA, i.e. 312.5 ohms. A 330-ohm resistor would suffice.

FIG 3

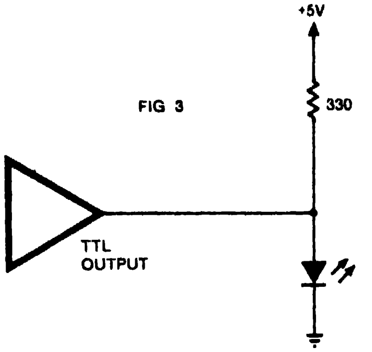
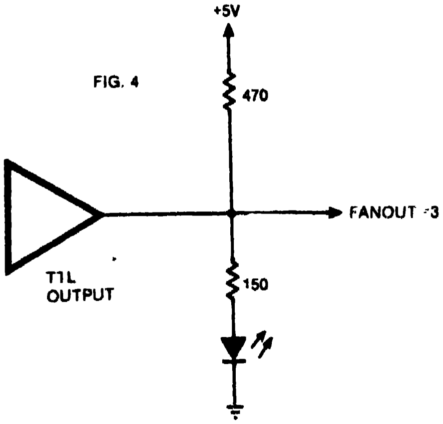


FIG. 4

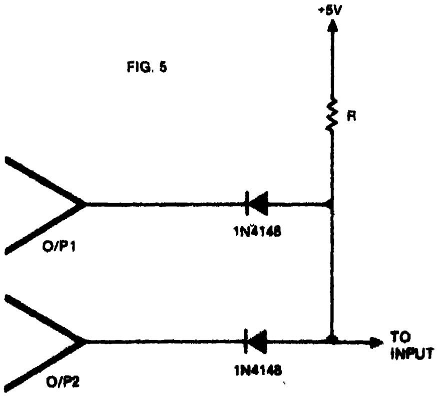


However, the TTL output can no longer drive TTL inputs since in 'logic 1' state, the maximum output voltage is limited to about 1.6V by the LED as against the minimum of 2V required by a TTL input for 'logic 1' state. This problem could be overcome by the circuit of Fig. 4, with a slight reduction in brightness level of the LED. It has a fanout of 3 TTL inputs. The circuits apply to LEDs of all colours.

Fanout. The fanout of TTL outputs (totem pole) is 10 in logic '0' state while it is 20 in logic '1' state. Sometimes, the fanout capacity of an output may be exceeded without the designer knowing it. In many occasions, overloading can be prevented. It is a common practice to form inverters out of NAND or NOR gates by shorting their inputs together.

However, the same results could be obtained by using only one input of the NAND or NOR gate and tying the other inputs to +5V (NAND) or to 0V (NOR). This reduces unnecessary load of the driving TTL output.

FIG. 5



Noise margin. In many EFY circuits, I have seen diodes being wired as AND gates as shown in Fig. 5.

This type of arrangement, which is economical, may work with CMOS ICs but should never be attempted on TTL. The reason for this is that the maximum input voltage at a TTL input for it to recognise it as 'logic 0' is only 0.8V.

However, by using diodes as NAND gates, there would be an unavoidable 0.7V drop across them. This, in combination with the 0.4V output voltage of the TTL output would raise the voltage at the input to 1.1 volt in 'logic 0' state. Thus we have a negative noise margin of 0.3V!

Why TTL? Yes, I am asking, why use TTL ICs? TTL ICs are greedy and power consuming and require a precise 5V ±5 per cent supply. CMOS, on the other hand, could be operated off 3V to 15V, their quiescent current being a few microamperes.

In EFY, I am pained to see circuits like 'heads or tails', 'dice', etc all designed with TTL ICs. These circuits could in fact be cheaply constructed with CMOS with the advantages of lower current consumption and wider supply voltage range.

The only advantage of TTL over CMOS is the former's high speed. But in a majority of applications, speed isn't the prime concern. Moreover, a single chip like the 4017 could replace 7490 plus 7442.

In many foreign magazines, CMOS ICs are mostly used in simple circuits that don't require high speed. And even when high speed is required, LSTTL is used instead of standard TTL which is far less greedy than TTL and is cheaper too I don't understand why EFY should not adopt the same practice.

R. SHANKAR
Madras

Electronic Typewriters

This has reference to the April issue of your magazine wherein you have brought out special supplement on 'Electronic Typewriters'. On screening through the feature a lot many deficiencies and discrepencies in the article have surfaced to light. We find that our name has not figured amongst the manufacturers of electronic typewriters although, as on today, we are their single largest manufacturer.

The typewriters manufactured by us are sold in various brand names such as 'Tacker' (by Communication Services (India) Pvt Ltd), 'Gestetner' (by Indian Duplicator Co. Ltd), and 'IRS' (by Indian Reprographic Systems Limited—a division of Modi Xerox). We are also marketing these typewriters in our brand name 'Sun Play-Word'.

The following parties whom you have mentioned as manufacturer are indeed only marketing the product and do not possess any manufacturing licence:

1. Advani-Oerlikon Ltd,
   Ador House, 6K Dubash Marg,
   Bombay.

2. Indian Duplicator Co. Ltd,
6 Bahadur Shah Zafar Marg,
New Delhi 110002.
3 Indian Reprographic Systems Ltd,
1st Floor, Plaza Cinema Bldg,
Connaught Circus,
New Delhi 110001.
4. Kaycee Business Machines Pvt Ltd,
N-10 Greater Kailash-I,
New Delhi 110048.
5. Methodex Systems Pvt Ltd,
607-8 Meghdoot, 94 Nehru Place,
New Delhi 110019.
6 Pertech Computers Ltd,
22 Mahatma Gandhi Marg,
Lajpat Nagar IV,
Ring Road,
New Delhi 110024.
7. Roneo Vickers India Ltd,
N-37 Connaught Place,
New Delhi 110001.
8. Supreme Computers Systems,
12 Okhla Industrial Area,
Phase II,
New Delhi 110020.
9. Trident Electronics,
2 Chowringhee Mansion, D. Kyd Street,
Calcutta 700016

We would appreciate if in future a careful indepth study is made before publishing anything in your magazine which has today reached the stage of reasonable credibility.

P.D.S. SAWHNEY
WBM Systems Pvt Ltd,
K-36 Connaught Place
New Delhi 110001

□ We thank you for including our address under 'Prominent Manufacturers of Electronic Typewriters' in your April issue, but were surprised since the specifications and features of Logic Systems electronic typewriters have not been indicated in the special feature titled 'Buying Guide to Electronic Typewriters.'

Logic Systems Pvt Ltd are the only manufacturers of trilingual (English, Hindi and Marathi) electronic typewriters with unlimited memory capacity In addition to this, the Logic Systems electronic typewriter has been tested and certified by the Electronics Regional Test Laboratory and recommended by the Department of Official Languages, Ministry of Home Affairs, Government of India, New Delhi to all government sector undertakings for the implementation of Hindi as official language

LOGIC SYSTEMS PVT LTD
D-30 Defence Colony
New Delhi 110024

Recent Trends in Amateur Radio

Several dramatic changes have taken place in the ham scene in the last couple of years, which have already given and are likely to give a further quantum boost to amateur radio activities.

First of all, imports of amateur radio equipment (up to Rs 10,000) were placed on OGL. This enabled a few hundred amateurs, starved for equipment, to get the latest rigs and come on the air. Most of the imports have been from Japan—Yaesu and Icom.

The second dramatic action was the waiving of import duty, which enabled some more amateurs to go in for imported sophisticated rigs at an affordable price.

And bang came the third stroke of concessions—the enhancement of the value of imported equipment to Rs 15,000

Although all these concessions are for one year, there is every possibility of their being extended indefinitely.

While many organisations and individuals are claiming credit for these miraculous changes, there is no doubt that these would have been impossible but for the personal interest and enthusiasm of Rajiv Gandhi, VU2RG. And I suspect that his motives go far beyond helping a few individual hams. He is concerned with the rapid development of electronics in India, and taking it to the towns and villages all over India. Which is fine for the country and a bonanza for hams!

That is not the end of the story. Substantial funds have been made available by the Department of Electronics (DoE) for the development of amateur radio (again probably at the instance of Rajiv, VU2RG). Strangely, all these funds have so far gone to National Institute of Amateur Radio in Hyderabad, a very recently formed organisation, without the requisite history or experience of service to amateurs, and to the total exclusion of long established organisations such as FARSI and RESI

However in view of protests from some organisations which were far more widespread and influential than NIAR, and who had a proven record, the DoE has woken up to the need for a close look at the distribution of funds

Not wanting to take a lead in the matter, the DoE arranged a thinly veiled conference of "all radio amateurs" by an individual B.S. Nargas, VU2BSN. While the modus operandi of the DoE can be questioned, there is no doubt that a closer liaison between ham organisations and the government was desirable.

The meeting called on April 12 by Mr Nargas was purportedly a meeting of all India radio amateurs by an individual, but the DoE was obviously behind it Nothing wrong in this, but where was the need to disguise the involvement of DoE? We have to work hand in glove. The persons present at the meeting were some officials and about 85 hams.

C.P. Joshi, VU2CPJ, presiding over this meeting, gave an 'extraordinarily long talk' on the history of amateur radio which was quite irrelevant as we know all about our own history—probably he thought he was talking to a bunch of laymen. No harm done, except this left little time for the main business of the day!

The key proposal came from the chairman: "It is decided to form an apex body for coordination and to project the image of amateur radio and distribute work. Also to give guidelines for future working, especially regarding emergency communications. We will distribute work to clubs and societies."

This proposal was accepted but before this could be adopted there were several pleas by FARSI and NIAR, asking that their organisations should be recognised as the apex body. While FARSI gracefully withdrew stating that, since their claim was disputed, they would agree on a new body for policy matters.

The members of NIAR repeatedly insisted on NIAR being recognised as the sole apex body and, finally after the decision was taken, S. Suri, VU2MY, director of NIAR, made a forceful plea on behalf of NIAR. Since the stage of considering an existing organisation had passed, Mr Suri's eloquence did not produce concrete results.

The newly formed 'Indian Council for Radio Amateurs' (ICRA) consists of:

Chairman: C.P. Joshi, VU2CPJ
Rep. of FARSI Saad Ali, VU2ST (or rep. by President, FARSI)
Rep. of NIAR
Rep. of ARSI—(if they decided to participate)
Rep. of Department of Electronics
Rep. of WPC (Min of Com.)
K. Venkatraman, VU2KV
Sahiruddin, VU2SDN
Dr Kajla, VU2KAJ
B.S. Nargas, VU2BSN.

Personally, I was not happy at the representation given to ARSI which is a self-confessed failure and has declared its intention of closing down. They did not even send a rep to the meeting, though Delhi-based.

It was also not understood why 'non-aligned' individual hams got such an overwhelming representation! They are a small fraction of the ham population. On the other hand, FARSI with its 70 clubs and 1400 hams got just one seat. And B.S. Nargas, VU2BSN, never heard of in organisational work, is suddenly catapulted into a key position.

It is presumed that ICRA will confine itself to:

(a) policy matters,
(b) liaison with the government, and
(c) coordination of various clubs and their activities.

It will not supplant any existing organisation but supplement their activities. Presumably, the government funds will be chanelled through it.

Unfortunately, the meeting was terminated as soon as the Council was appointed. It would have been better if the chairman had some patience and gone into the constitution, functions, modus operandi and funding of ICRA.

Be that as it may, there is no doubt that this is a significant and revolutionary step in the development of amateur radio, and should give a big boost to ham activities.

SAAD ALI, VU2ST
Bombay

Some Appreciations

The serial 'Comparative Study of Computer Languages' by Mr R. Ramaswamy is very informal and nice. I request you to publish more of such articles, and some BASIC programs of the type carried in the March issue.

RAJNISH KUMAR
Shillong

□ I am a subscriber of EFY since 1982. I find the standard of the magazine is widely improving. The article by Mr Y.K. Shah on 'CMOS Technology: Catching Up' in Feb.'86 issue was very informative and lucid.

R. AYYAPPAN
Gudalur

Manufacturers - Electronics

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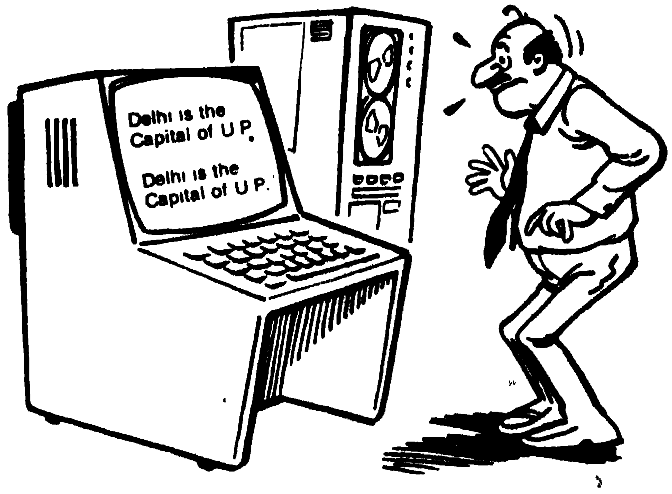
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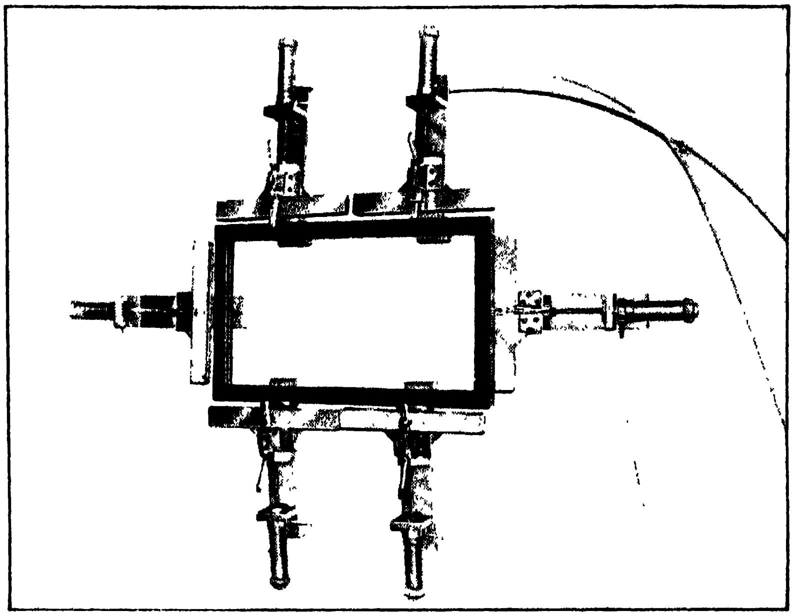
ARS/WIE 001

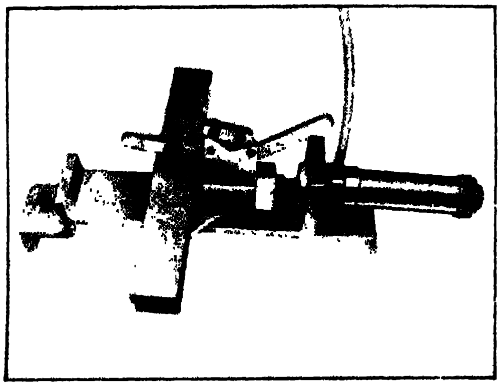
Screen Stretching Clamps for high quality, fine line resolution, screen printing.



An essential prerequisite for high quality printing and durability of the stencil is the proper stretching of the gauze. The stretching clamps have been designed keeping in mind various factors that govern the preparation of screens for the printing of etch resist, solder mask, lettering and legend printing, and, various other applications in the screen printing industry.

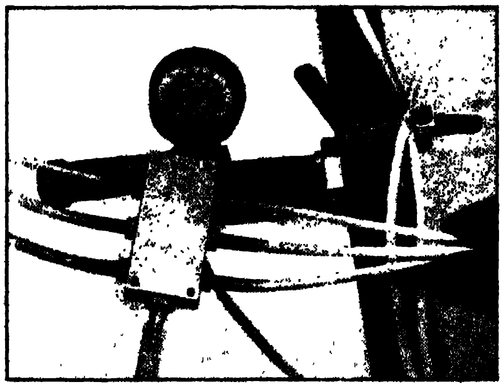
Special Features

- Cast aluminium upper and lower jaws engineered to precision
- Rubber lined jaws for fabric safety
- High accuracy pressure guage supplied as standard feature with every system.
- Valves and pressure cylinders designed keeping in mind substantial safety margins



Individual jaw complete with quick action clamp and pressure cylinder. A single system can comprise of as many clamps as desired.
←

→
Pressure guage with distributor and pressure lines.



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PSA/TM/2/84

IN INDIA....

Approvals for VCR production

The Secretariat of Industrial Approvals (SIA) has finally accepted 12 applications out of 60 requests for manufacturing VCRs. SIA is evaluating these applications in consultation with the Department of Electronics (DoE) to accord clearances.

The major foreign collaborators in the race for VCR technology are the Japanese companies including Sharp, Akai, National and Sanyo. DoE has also decided to consider the Philips proposal seeking the manufacture of colour TV sets, VCRs and microwave ovens.

DoE had issued norms for filing applications. One of the major requirements was that the applicant should give an assurance to indigenise the manufacture of VCRs within four years. It was also required that the applicant should specify the timeframe for manufacturing VCRs with CKD/SKD imports. DoE had clarified that preference would be given to the collaborations which laid maximum stress on indigenisation and quicker technology transfer.

The demand for VCRs is estimated to be around 500,000 per annum by the end of the Seventh Plan period. Every selected unit would manufacture 50,000 units with a provision of further expansion, depending on the market conditions.

Telephone targets exceeded

The Telecommunications Department has exceeded the target for additional capacity to the local telephone network, set at 300,000 for the year 1985-86 by 17 per cent at 357,000. The utilisation of capacity of giving new telephone connections has also achieved a number of 267,000 against the target of 220,000, exceeding by 21 per cent. This takes the total number of working connections in the country as on March 31, 1986, to 3,165,642 and the total exchange capacity to 3,664,042.

At present, the telecom services to neighbouring countries like Pakistan, Nepal, Bhutan, Bangladesh and Sri Lanka are provided through reliable broadband media. Adequate provision is available for the introduction of fully automatic telephone service on dialling basis as well as telex facilities.

Six more trunk automatic exchanges have been expanded with a total capacity of 5400 lines in 1985-86. During the current financial year, it is proposed to commission digital trunk automatic exchanges at Agra (2000), Pune (3000), Trichy (2000) and Lucknow (1000). Twenty-one more telex exchanges have been added to the network, adding to the capacity of 1580 lines, totalling the capacity to 40,674. The number of telex connections given during the year is 4302 and the total telex working connections stand at 30,515.

To improve the telecommunication services through adoption of modern technology, a decision has been taken to computerise the directory enquiry service (197) and trunk manual exchanges. It is proposed to extend these facilities to 32 important stations in the country. It has been decided to carry out feasibility studies for extending the mobile radio telephone service to Bombay and the national capital region. Radio paging service, which has been introduced at Delhi, will be further extended to ten more stations.

INSAT 1C launch in '87

INSAT 1C, the third in the series of multipurpose domestic satellites, is now likely to be launched in April 1987. The satellite is meant to be an on-orbit spare for the INSAT 1B which is now operating in its three segments since the last 32 months.

The satellite which was scheduled to be launched on-board the US space shuttle is now without a launch vehicle since the Challenger tragedy which took place in January 1986 and subsequently the Delta rocket disaster this month.

However, India may still opt for using an unmanned Delta rocket for launching the INSAT 1C, despite the accident.

Eighth effective business systems exhibition

After the overwhelming response to the 7th Effective Business Systems exhibition organised in Bombay in March earlier this year, the 8th exhibition has been scheduled for October 23-25, a second show in the same calendar year.

This is India's largest trade exhibition for manufacturers of data processing systems, office and drawing office equipment, communication aids and business gifts. Over 50 leading companies regularly participate in the trade show which attracts innumerous senior level professionals.

Further details about the exhibition can be obtained from Trans Asia Trade Fairs & Expositions Pvt Ltd, 1st Floor, Jeevan Sahakar, Sir P.M. Road, Bombay 400001.

Wescon '86

The Wescon '86 trade show, one of the prestigious events in the field of electronics held annually in the USA, is to be held from November 18 to 21, later this year. The Trade Development Authority (TDA) is organising India's participation in the show.

Last year, India's first ever participation in the fair generated an enormous amount of interest and was an eye opener for visitors. A large amount of business was also generated by the Indian firms at Wescon '85. The production range that is displayed at the fair includes active, passive and electromechanical components, test and measuring instruments as well as computer and accessories including software.

Further information regarding participation can be obtained from Mr V.S. Mehta, Assistant Merchandising Executive, TDA, P.O. Box 767, Bank of Baroda Building, 16 Sansad Marg, New Delhi 110001.

Contracts for telecommunication

Three technologies relating to electronic PABX equipment have been approved by the government for transfer of technology to the private and public sectors. These are: (i) Jeumont Schneider, France; (ii) GTE, Belgium; and (iii) OKI, Japan. These technologies cover the sizes of exchanges from six lines to 2000 lines. The government has placed purchase order of 20,000 EPABX lines on these firms for field trial.

Though at the time of the agreement indigenous technology was not available, the Centre for Development of Telematics (CDoT) has subsequently developed a 128-line EPABX as a by-product of the main development programme for developing a large capacity electronic telephone exchange. The purchase of technology from abroad involves exchanges of capacity from six lines to 2000 lines as compared to 128 lines EPABX developed by CDoT.

A conference at New Delhi was held recently to apprise the manufacturers of different production processes and documents prepared by CDoT. The documents covered engineering, production and user aspect. So far 42 manufacturers have entered into agreement with CDoT for technology transfer on PABX. Each licencee has to manufacture at least 1000 lines annually, the licensed capacity of each manufacturer being 20,000 lines per annum.

List of Manufacturers Collaborating with CDoT for Production of PABX

Delhi

1 Auto Controls (P) Ltd
414 New Delhi House
Barakhamba Road
New Delhi 110001

2 Capital Radio Co
Chintamani House
Daryaganj
New Delhi 110002

3 DCM Data Products
Vikrant Tower
4 Rajendra Place
New Delhi 110008

4. Debikey Information Technology
Debikey House
B-46 Soami Nagar
Outer Ring Road
New Delhi 110017

5 Finmac Systems Ltd
512 Mansarovar Bldg
90 Nehru Place
New Delhi 110019

6 Genesis India (P) Ltd
A-15 Kailash Colony
New Delhi 110048

7. Hindustan Telecom Ltd
Siddhartha, 96 Nehru Place
New Delhi 110019

8 J&K State Indl Dev. Corpn Ltd
1112 Chiranjiv Tower
43 Nehru Place
New Delhi 110019

9 Magnum International Trading Co (P) Ltd
48/1 Commercial Centre
Malcha Marg
Chanakyapuri
New Delhi 110021

10. Magnavision Electronics Ltd
26 Gulmohar Enclave
New Delhi 110049

11. Wipro Information Technology Ltd
1107 Hemkunt Tower
98 Nehru Place
New Delhi 110019

Bombay

12. The Gwalior Rayon Silk Mfg Wvg Co. Ltd
808 Dalamal House
206 Nariman Point
Bombay 400021

13. Hindustan Brown Boveri Ltd
22-A Shah Indl Estate
Off Veerdesai Road, Andheri (W)
Bombay 400058

14. Maharashtra Electronics Corpn Limited
(MELTRON)
Raheja Centre, 13th Floor
Nariman Point
Bombay 400021

15. The National Radio & Electronics Co Ltd
(NELCO)
Mahakali Road, Chakala
Andheri (E)
Bombay 400093

16. Pantex Engg (P) Ltd
Bharat Velvet Mills Compound
Safed Poon Sakinaka
Sir M Vasantji Road
Bombay 400072

Madras

17. Best & Crompton Engg Ltd
29 Rajaji Salai
Madras 600001

18 Indchem Electronics
Sudarshan Gardens
Valachery Road
Guindy
Madras 600032

19. W S Insulators of India Limited
Porur
Madras 602104

Bangalore

20 Bharat Heavy Electricals Limited
(Control Equipment Divn)
Mysore Road
Bangalore 560026

21 Cosmo Communication (P) Ltd
Block II, Koramangala
Layout
Bangalore 560034

22 Karnataka State Electronics
Development Corpn Ltd
Race Course Road
Bangalore 560001

23. United Telecom (P) Ltd
68 Lavelle Road
Bangalore 560001

Others

24. Indian Telephone Industries Limited
Palghat

25. Andhra Pradesh Electronics
Development Corpn Ltd
Parishrama Bhavanam
8th Floor
Basheer Bagh
Hyderabad 500029

26. Sujatha Telecom Ltd
16 Srinath Complex
4th Floor
58 S.D. Road
Secunderabad

27. Ultramatix Survey
82/1, Plot-20 Sahkarnagar
Parvati
Pune 411009

28 Wester India Enterprises Ltd
Shashi Chambers
Pune Satara Road
Pune

29. Advani Oerlikon Limited
Milestone 4/15
Nagar Road
Pune 411014

30. The Arvind Mills Ltd
Railwaypura Post
Baroda Road
P.B. No. 56
Ahmedabad 380025

31 Gujarat Narmada Valley Fertilisers Co. Ltd
P.O. Narmada Nagar
Distt Bharuch
Gujarat

32. Suvik Electronics
GIDC Engg Estate
Plot No. 102
Gandhi Nagar 382028
Gujarat

33. Gujarat Telematics Ltd & Digital
Innovations (P) Ltd
C/o Gujarat Communications &
Electronics Ltd
GIDC Makarapura
Baroda (Gujarat)

34. Digital Innovations (P) Ltd
B.N. Chambers Road
Vadodara 390005

35 Arlem Breweries
C/o Chowgule & Co
Marmagoa Harbour
Goa 403803

36. Rajasthan State Indl Dev. & Investment
Corpn Ltd
Udyog Bhavan
Tilak Marg
Jaipur

37. Kalindi Rail Nirman Engg Ltd
F-56 Kalidass Marg
Jaipur 302006

38. Central Electronics Ltd
4 Industrial Area
Sahibabad 201010

39. Radiant Electronics
623 Shahid Nagar
Janpath
Bhubaneshwar 751007

40. Naina Electronics Pvt Ltd
181/6 Industrial Area
Chandigarh

41. Punjab Communications Ltd
C-32, Phase II
Mohali
SAS Nagar
Via Chandigarh

42. Assam Electronics Dev. Corpn Ltd
Industrial Estate
Bamunimaidan
Guwahati 21

Boost for electronics in Rajasthan

The Rajasthan government recently announced several new incentives to attract investment in the electronics sector in the state. The state government has initiated measures to generate investment of around Rs 4000 million in this sector. The Rajasthan State Industrial Development and Investment Corporation (RIICO) has been assigned the key role in attaining this target.

The incentives allowed to the industry include a tax holiday for the duration of the Seventh Plan for new electronics units which start production during the period. Also entrepreneurs setting up units during the Seventh Plan will not be required to pay any state or central sales tax.

Some concessions will also be available to existing electronics industries. The rate of sales tax will be cut to only 4 per cent for them Units expanding capacities during the Seventh Plan to the tune of 50 per cent or more will also get a tax holiday for five years.

The new projects are scheduled to come up at Vigyan Nagar Industrial Area, some 100 km from Delhi along the national highway to Jaipur. The 60-hectare zone has been reserved for electronics and high-tech projects. Apart from 15 per cent rebate on cost of land, a subsidy will also be given on the cost of knowhow and feasibility reports.

Two international fairs in India

The US-based Cahners Exposition Group (CEG) and London-based Industrial Trade Fair International Ltd (ITFI) have now joined forces in combining two international trade fairs in New Delhi.

ITFI's Communications India '86 event scheduled to be held in Bombay will now be combined with CEG's India Comm '87 exhibition and held in New Delhi during January 28-31, 1987. Also ITFI's Electronics India '86 has been combined with CEG's Internepcon Semiconductor '86. This will also be held in New Delhi on November 4-7, 1986.

With the emphasis laid on the electronics industry by the Indian government, several foreign manufacturers and suppliers are eager to explore the Indian market. India Comm '87, India's first international telecom and computer exhibition and conference has been prompted by the projections made in this field over the next four years. While production of small computers is expected to jump from 4760 in 1984-85 to 38,300 in 1989-90, investments in Indian telecom are expected to rise from US $ 221 million to US $ 10,520 million in the same period.

Internepcon Semiconductor '86 which will be India's first international PCB and semiconductor manufacturing exhibition and conference is going to feature production equipment and components for PCB and semiconductor device industry. This event has the support of the governments of India, the USA and the UK

Both exhibitions are expected to generate a good amount of business as manufacturers and suppliers from at least 14 countries are expected to participate

.AND ABROAD

Laser 'sees' interconnections

Prefabricated chips of standardised design may be modified for specific tasks by means of laser beams. By separating selected connections in the pattern of conducting paths, the integrated circuit becomes an individualised device Siemens has developed an electronic circuit which guides the laser beam rapidly and with high accuracy—an essential job for a highly-complex logic circuit requiring separation of up to 10,000 connections of this type.

This device automatically detects the location of a connection point within 30 ms. The new image-processing circuitry can distinguish 256 grey shades of varying brightness between black and white. This range of fine shadings allows the laser to 'see' a connection point with an accuracy of 0.3 μm. The electronic circuit guides the laser beam from one separation point to another until all superfluous connections have been severed. The image-processing system keeps its eye on the process, making sure that any incomplete separations are repeated.

Telecom '87

Telecom '87, the fifth in a series of world telecommunication exhibitions, will be held from October 20 to 27, 1987 at Geneva's exhibition and conference centre, PALEXPO.

Under the theme 'Communications Age: Networks and Services for a World of Nations', Telecom '87 will bring together over 600 exhibitors from all parts of the world and will display the state-of-the-art in equipment and technology. Telecom '87 will also give a glimpse of the future in the rapidly evolving field of telecommunications through demonstrations of prototype equipment yet to come to the market. Telecom is for many manufacturers an occasion to unveil new products and to indicate what is on their R&D drawing board.

World telecom exhibitions are organised by the International Telecommunication Union (ITU) to keep the members of the union informed of the latest advances in telecom techniques and in publicising the possibilities of applying telecom science and technology for the benefit of the developing countries. ITU world telecommunication exhibitions are recognised as the world's largest and most universal telecommunication exhibitions.

Public and private sector operators as well as manufacturers and suppliers of telecommunication equipment of 34 countries, including India, are already participating in Telecom '87. Associated events stated for the Telecom '87 include Forum '87, symposiums on the executive, technical and legal aspects of telecom, a book and audiovisual fair, a film festival and an international competition on the 'Youth in the electronic age '87'.

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AT&T and SGS have signed a five-year marketing and development agreement which covers the marketing and sale of linear bipolar and high voltage integrated circuits widely used in telecommunications, data processing, and a broad range of industrial applications.

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AT&T's strengths in semiconductor technologies, in combination with an SGS international sales force, broad customer base and extensive product family, is expected to give customers around the world access to a unique set of custom and catalogue devices.

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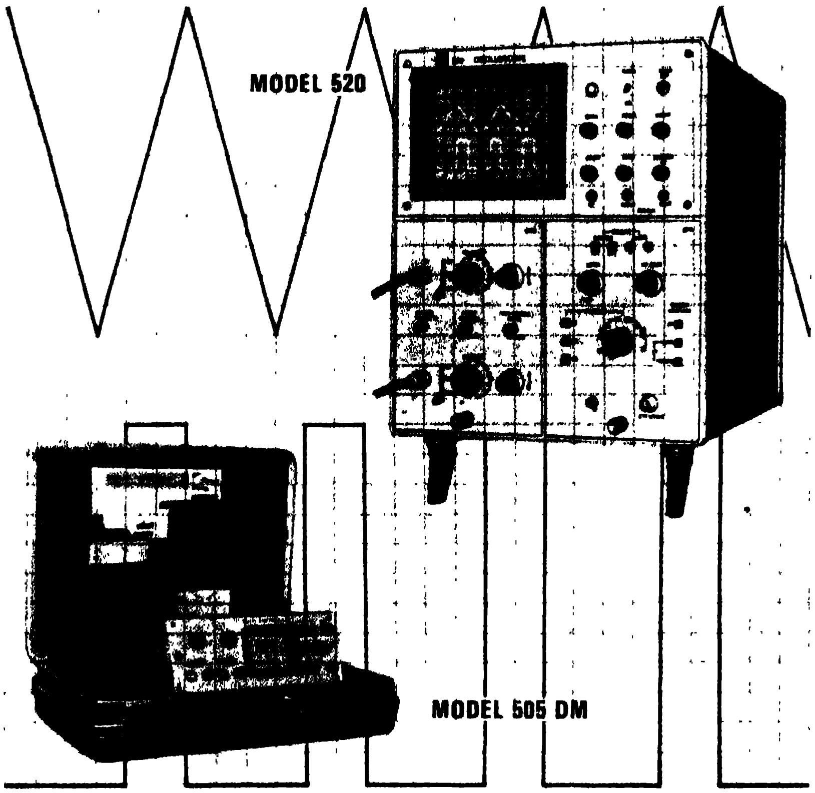

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Magnetisers and Magnetising Fixtures

P.D. Joshi

As manufactured, any permanent magnet is an inert piece of metal or ceramic (ferrite), until it has been magnetised (or energised) by an appropriate external magnetic field. Special equipment have been developed to magnetise, demagnetise, stabilise and calibrate all types of permanent magnets. Though magnetising is the most commonly used term, the operation is also described as charging or energising of magnet.

In-situ magnetising

A magnet can be energised either before or after the assembly. But it is preferable to first assemble the magnet and then magnetise it in the assembly, i.e. in-situ magnetising. This is done in applications like loudspeakers, magnetoes of two-wheelers, DC motors etc. The various technical and commercial advantages of in-situ magnetising are:

1. If the magnet is magnetised first and then assembled, there will be five to ten per cent loss of flux in ferrite magnets and even more in Alnico. This is due to shift in working point along the B-H curve.
2. Magnetised magnets attract all iron-bearing impurities during handling and assembly. These impurities may adversely affect the performance of magnetic assembly.
3. If the magnets are in energised condition, then assembling becomes difficult.
4. The time and expense incurred in magnetising individual magnets is more than in-situ magnetising.

Principles of magnetisation

For magnetising the magnets as well as magnetic assemblies, the following are required:

—a magnetiser or a power supply, and

—a suitably designed magnetising fixture.

The basic purpose of any magnetiser is to supply unidirectional magnetic field of the proper magnitude, shape and time duration, to fully saturate the permanent magnets. Generally, for fully saturating the magnets, a magnetising field of little more than four times the intrinsic coercivity of that magnet's material is required. The intrinsic coercivity of the different magnet materials is given in their manufacturers' catalogues. The shape and time duration of applied magnetic field depends on the magnetising fixture design.

MAGNETISERS

There are three methods of energising the magnets: (a) by the use of permanent magnets, (b) impulse or capacitor discharge magnetisers, and (c) by the use of DC electromagnets.

By the use of permanent magnets

Permanent magnets are used for magnetising extremely small magnets of simple shapes like rods and slabs. These permanent-magnet magnetisers consist of a basic magnet, with high ratio of energy per unit volume and adjustable mild steel pole pieces. Thus the air gap can be adjusted to fit the magnets being energised. Due to limitations of size and shape, these magnetisers are rarely used.

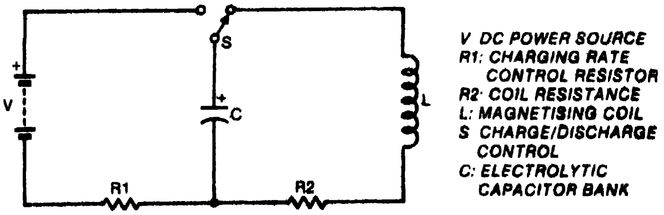

+
V
S
+
C
L
R1
R2
V DC POWER SOURCE
R1: CHARGING RATE CONTROL RESISTOR
R2 COIL RESISTANCE
L: MAGNETISING COIL
S CHARGE/DISCHARGE CONTROL
C: ELECTROLYTIC CAPACITOR BANK

Fig. 1: General circuit for impulse or capacitor discharge magnetisers.

Impulse or capacitor discharge magnetisers

Electrolytic capacitors are used to store the energy over a period of one to ten seconds. This energy is then rapidly discharged in some milliseconds (by a control circuit) into a magnetising fixture. The magnetising fixture produces the

---

Mr Joshi is an application engineer in Morris Electronics Ltd. This article from him is likely to be of general interest to many but particularly to the firms making loudspeakers and magnetoes etc.

magnetic field required to energise a magnet. A high-power SCR (silicon controlled rectifier) is used to control charging and discharging of capacitors. In large capacity models, an output transformer with high-voltage primary and a high-current (low-voltage) secondary is used for electrical circuit and personnel safety.

Impulse magnetisers are rated by their capacity to deliver energy in joules (watt-seconds). The time over which the energy is delivered is determined by the impedance of fixture coil in relation to the output impedance of the magnetiser itself. Ideally, for maximum energy transfer, the output impedance of the magnetiser and the input impedance of the magnetising fixture coil should match. However, the input impedance of the magnetising fixture varies with specific fixture. Hence such a condition is difficult to obtain in practice. The amplitude of the applied magnetic field can be adjusted by varying the capacitor voltage.

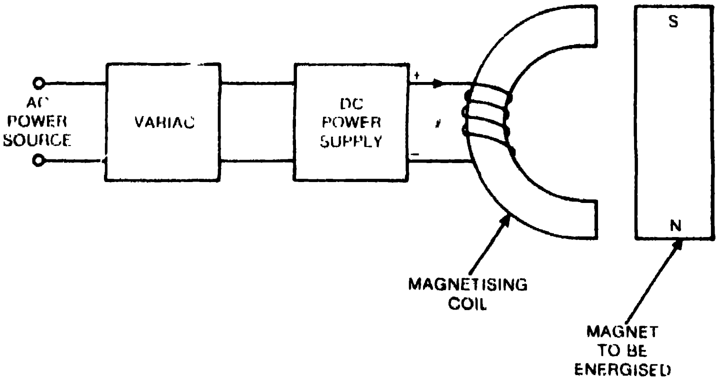


Fig. 2: Formation of DC electromagnets.

Impulse magnetisers are widely used for magnetising magnetoes of two-wheelers, loudspeakers, small DC motors etc.

DC electromagnets

These are iron-core electromagnets energised by well filtered direct current.

The high inductance of DC electromagnetic magnetisers requires a time interval of two to five seconds for the magnetic field to reach full magnitude. A substantial time is required for the field to collapse. Premature removal of the magnetised magnet is not only physically difficult but may result in partial demagnetisation. A variac is used to adjust the magnetising field strength.

Comparison of impulse magnetiser and DC electromagnetiser

In a DC electromagnet the time required for build up and collapse of the field is high. Hence, the time required for energising a magnet is more. This slows down the production rate. Impulse magnetisers take less time for magnetisation.

The power lost in heating of coil is more in DC electromagnets than in impulse magnetisers. So impulse magnetisers have better power efficiency.

DC electromagnets are better for energising large size magnets.

DC electromagnets can be used only for energising simple shaped bipolar magnets, whereas impulse magnetisers can be used for bipolar as well as multipole magnets.

The efficiency of electromagnets can be improved by controlling the time for which input current is applied. These are known as semi-continuous DC electromagnets.

DC electromagnets need forced air cooling or even water cooling. Hence, they are large sized and bulky.

MAGNETISING FIXTURES

As mentioned above, the shape and time duration of the magnetising field are important factors besides its amplitude. These two are decided by the magnetising fixture design.

A magnetising fixture essentially consists of a coil or winding of insulated copper wire or strip, a yoke of mild steel or silicon iron stampings, cooling arrangements (if needed), and pole pieces (if needed) for concentrating the magnetic field in desired shape.

Coil

Coil is the most important part of magnetising fixtures. The coil may be of single turn or multiturns, depending on the amplitude of the magnetising field required. Amplitude of the magnetising field is measured in ampere turns/metre.

The shape, size, winding pattern, resistance and inductance of coil are the important design criteria. The shape and size will depend on the magnet to be energised. The winding pattern will depend on number and positions of poles on the magnet. The resistance and inductance will depend upon the wire gauge, number of turns and the core material used.

Yoke

A yoke is used to provide path for magnetic flux and to

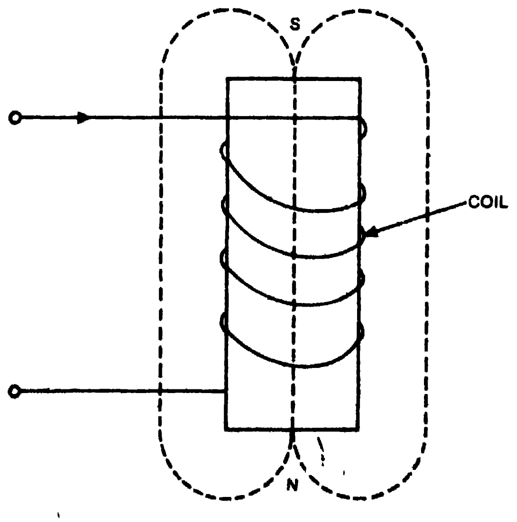


Fig. 3: Formation of north and south poles in an electromagnet.

avoid effects of stray magnetic fields. Mostly mild steel is used for the yoke and silicon iron stampings for the core. The yoke helps in heat dissipation.

The direction of current through the winding decides the direction of the magnetic field, which in turn determines the pole (north or south).

If a coil is wound around a rod-shaped magnet, and a DC current passed through it, the magnetic field produced will be shown by dotted lines as in Fig. 3. A north pole will be produced at the one end and south at the other.

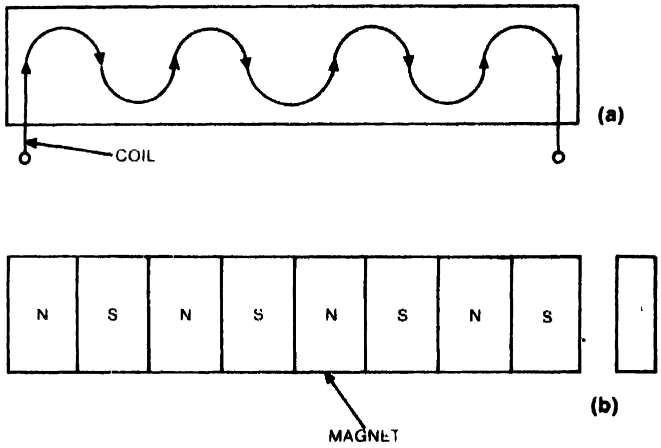


Fig. 4: Creation of multiple poles in a magnet.

If a coil is wound as shown in Fig. 4(a) in a zig-zag fashion, direction of the current in adjacent turns is opposite to each other. Hence the magnet, after magnetisation, will have multiple poles, as shown in Fig. 4(b). In all there will be six poles on the surface of the slab-shaped magnet. North and south poles will be adjacent to each other, and there will be three pairs of north and south poles.

Design considerations of the coil

The coil should be as near to the magnet as possible, so as to get the maximum possible magnetic strength.

The resistance of the coil should be high enough so as to have sufficient time duration of the magnetising field.

Spurious electrical oscillations may occur in any type of magnetiser system, depending on the relationship of the magnetiser's output impedance to the magnetising fixture's input impedance. These oscillations produce field direction reversals in the magnetising coil, which can partially demagnetise the magnet. To avoid this some guidelines are given below.

Guidelines for magnetising fixture design

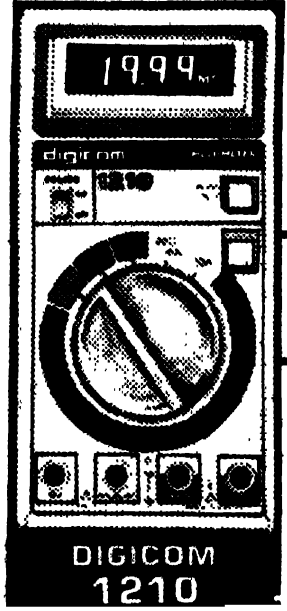
1. Water cooling is desirable when more than 2-3 parts are magnetised in a minute.
2. Copper tubes can be used for water cooled fixtures.
3. Maximum possible number of turns with a thick wire should be used.
4. The entire coil can be mounted in epoxy for safety and durability.
5. When pole pieces are used, they should always be placed as close as possible to the magnet's surface.
6. As far as possible, the magnetiser should be used at the lowest possible voltage to achieve magnetic saturation. Voltages higher than necessary can cause unnecessary damage and overheating in the fixture.

Two desirable aspects of magnetisation are:

1. The less than saturation magnetisation of a magnet is not desirable because it is difficult to control with consistency. If partial magnetisation is essential, then it is better to magnetise the magnet up to saturation and then knock it down, by demagnetisation, to the desired level.
2. When oriented (anisotropic) magnets are to be magnetised, the magnetising field should be parallel to the inherent orientation of the material.

Conclusion

The scope of this article has been only to enumerate basic principles, and some practical guidelines in selection and design of an appropriate magnetisation set-up. Precise relationships to enable ready design are difficult to define due to the unique nature of each application. Setting up a good magnetising facility is an art by itself and requires experience. □



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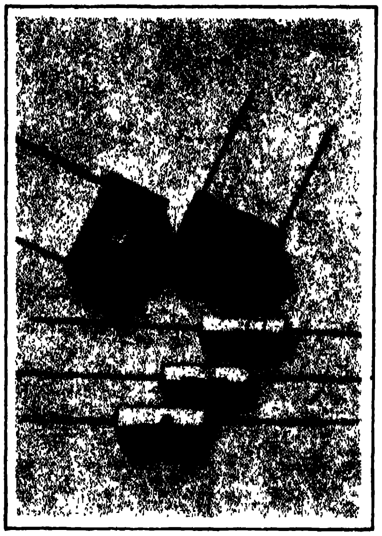

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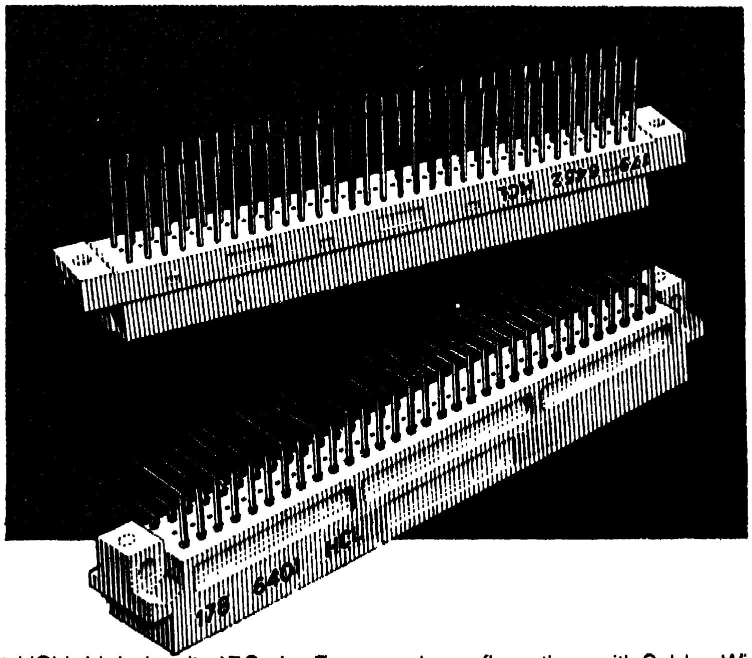

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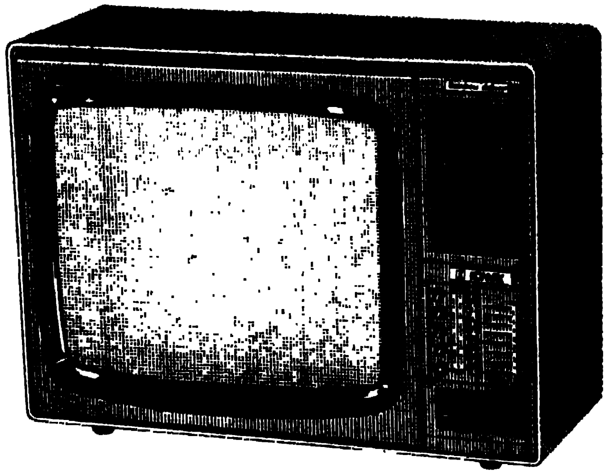

P.K. Subramanyam

The questions you always wanted to ask.
And the answers you never got!

Television set sizes are advertised as 30 cm, 36 cm, 51 cm etc. Do these refer to the width or height of the set?

These measures refer to the diagonal of the screen, i.e. the distance from the lower left corner to the upper right corner and not to the width or height of the screen, or of the cabinet.

Why is such a peculiar method adopted for specifying screen size?

This is due to historical reasons. When picture tubes were originally manufactured, they had a round face like the cathode ray tube in an oscilloscope. Hence the only possible specification was diameter. When a rectangular picture is presented on this screen, the diameter is equal to the diagonal, as shown in Fig. 1. This specification has continued without change.

Are the width and height of the TV screen related at all to the size in any manner?

Yes, they are related geometrically, i.e. by specifying size, the width and height are automatically specified as the width and height are in the ratio of 4:3. This is also the standard 'aspect ratio' of original cinema. Cinema has however developed new formats like vistavision, widescreen and cinemascope, and the new aspect ratios have increased up to 2.3:1 (Fig. 2). This is closer to the natural vision perspective.

So, if the diagonal of TV screen is 51 cm, then the width and height will be 40 cm and 30 cm approximately ($40^2 + 30^2 = 51^2$ approximately). Small variations may arise due to the cabinet which may be masking the edges of the screen.

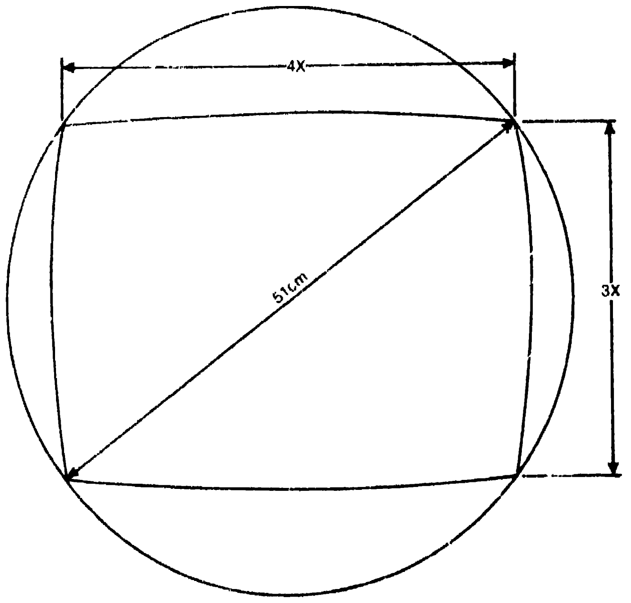

Fig. 1

What about cabinet dimensions?

These are based on aesthetics. At present only one manufacturer uses a cabinet with vertical spread. All others are offereing cabinets with horizontal spread, sometimes even extra spread with loudspeakers and controls on both sides of the screen. In any case, cabinet dimensions have nothing to do with the specification of 'size'.

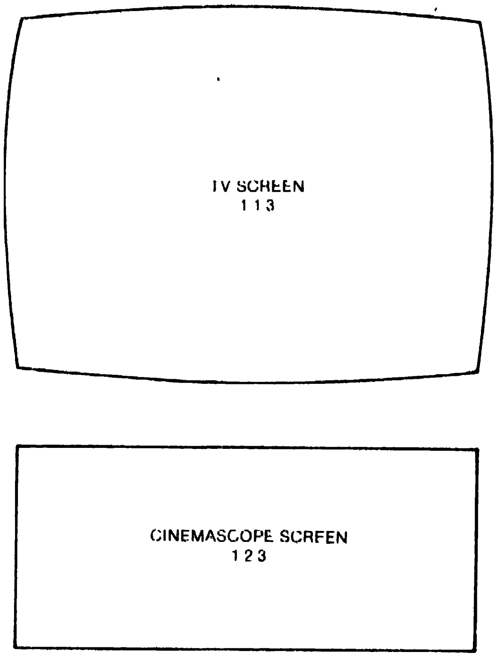

Fig. 2

Do other display devices also have the same aspect ratio?

Yes! Visual display devices such as computer terminals also generally use the same ratio, mostly due to manufacturing reasons. The same applies to VCR display monitors and television studio monitors.

What happens when cinemascope films are shown on TV?

Cinemascope films are shown quite frequently on TV in India. It will be noticed that the top and bottom portions of the screen are blank.

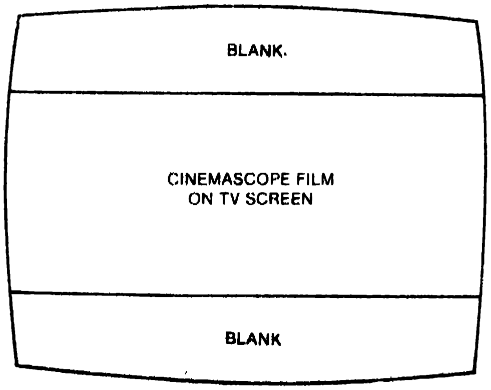

Fig. 3

What is the optimum watching distance?

The best viewing location is the one from where the horizontal lines on the TV screen are just not visible. This distance is about five times the size of the screen, i.e. about two metres for the 36cm set and three metres for the 51cm set. It is therefore better to have a smaller size TV if you have only a small room (and a small budget!)

What is the best placement—corner or wall?

For small rooms corner placement is more convenient, to allow enough space in front to be left free. Besides, it is well known that loudspeakers in a corner placement give better sound quality.

Unfortunately, TV manufacturers are forced to use smaller diameter loudspeakers of 12 cm to 18 cm whereas good radios can boast of 20 cm to 25 cm speakers!

Is TV watching harmful to the eye?

Watching any bright object for long hours is certainly harmful. The brightness of the TV screen is generally more than that of a bare tubelight. Hence it is like watching a tubelight! Add to it the sudden flickering and fluctuations due to commercials!

Should the room lights be switched off for watching TV?

No! The habit of watching in darkness is derived from cinema halls but need not be copied. One houselight may be kept 'on' while watching TV to avoid drastic changes of brightness which may affect the eye. This will mean a little less contrast in the picture, but it is worth it.

Is a roof-top antenna necessary at all?

Generally it has become a regular practice to buy antenna along with the set. Three-element antenna costs only about five per cent of the set's cost and it is taken for granted that the expenditure is negligible and hence worthwhile.

In India, there are only two types of TV stations the HPTs radiating about 10kW energy each and the LPTs transmitting only 100W each. The HPTs (high power transmitters) are provided with towers of 150 to 300 metres (150 Delhi, 300 Bombay) height. As such, within city limits a set-top (indoor) antenna or the one supplied with portables is sufficient. In suburbs an outdoor antenna may be needed to get better pictures.

In LPT (low power transmitter) towns, because of low power (100W) and low height (30 metres), a roof-top antenna may prove beneficial.

When should a booster be fitted?

Boosters are useful in fringe areas, i.e. 15-25 km from LPTs and 50-100 km from HPTs. In low signal areas colour is the first victim. The cost of a booster is less than five per cent of the cost of a colour set. Hence booster is worthwhile in these areas.

Where should the booster be fitted—at the mast top, in-between or near the set?

Normally at the mast, so that the signal is boosted at the source itself. However during rainy season, if the booster stops working, there is no way of getting a signal except by bringing down the mast and bypassing the booster. Therefore, as a compromise, the booster can be mounted half way so that it is accessible in such an emergency.

(As an experiment, the writer has used booster right at the set terminals and received good colour pictures of Bangladesh and Sri Lanka at Cuttack in Orissa.)

What is meant by the direction of the antenna?

The common three-element antenna is designed to receive TV signals well in one direction only. It consists of two single aluminium rods and one double rod in the centre. The longer single rod is the reflector, the smaller one the director. The central double rod is the actual antenna. These rods are fixed on a connecting rod which is fixed to the pole.

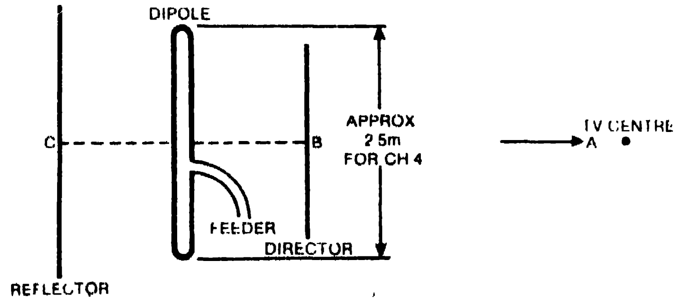

Fig. 4

The line (imaginary) from transmitting station should cut the director at right angles first, then the antenna, and then the reflector. In other words, the direction ABC (Fig. 4) is the direction of the antenna, and this should be looking towards the transmitter.

What is the use of these rods (director and reflector) when there is no connection from them to the feeder?

As there is no connection to these extra rods, the energy received by them from the incoming wave is re-radiated in such a way that when picked up by the central element it adds to the signal. Hence the gain of the antenna and its directional quality are enhanced.

Why is the central active element a double rod?

The central element is basically a 'dipole' (double element) and its characteristics are similar. It is hence called a folded dipole. The normal impedance of a dipole is 72 ohms. By folding we get the impedance raised four times, i.e. to about 300 ohms. This impedance matches the impedance of the twin-wire ribbon feeder of 300 ohms. The ribbon feeder's impedance also matches the input impedance of the TV set.

Apart from these, one practical advantage of the folded dipole is that the continuity of the feeder could be checked from the room itself by applying the feeder terminals to an ordinary avometer. If there is no continuity, it means there is a break in the wire or at the antenna terminals.

When both rods are aluminium pipes, what makes one a reflector and the other a director?

The reflector is longer than the central element, usually by about five per cent The director is shorter than the dipole by about five per cent. The difference in their lengths decides whether an element is capacitive or inductive at the concerned frequency, and this property decides if it has a 'leading current' or a 'lagging current'. More theory is not needed for recognising the elements.

Is the length of dipole related to the frequency or channel?

Yes, directly! Channel-4 of Madras, Delhi, Bombay, Calcutta, Lucknow and Srinagar uses a frequency of 61 MHz to 68 MHz. This is approximately five metres in wavelength. Hence the folded dipole is also about 2½ metres in length, which is the longest in India. The other transmitters and LPTs transmit in Band III, using channels 5 to 12 which have a frequency of about 180 MHz. So their antenna will be less than a metre.

Due to the small size and cost involved, it is possible to mount several directors for the higher channels. But usually only one reflector is used.

How is it that all antenna elements are mounted horizontally! Can they be mounted vertically also?

In India all TV transmissions are horizontally polarised (i.e. electric vector in the horizontal plane) as the transmitting antennae are horizontal. Hence the receiving antenna has to be horizontal.

In countries like the UK, with a large number of transmitters, H and V polarisations are used in addition to channels in order to separate the channels. Horizontal and vertical antennae, even on the same house-top, are therefore a common sight in such advanced countries. In India the geographical separation between the TV stations itself is so large that no further techniques are needed!

Can I turn the TV antenna upward and get satellite programmes?

No! Satellite programmes of INSAT are on a much higher frequency band (S band, C band in gigahertz range), and are very weak. With your normal antenna and TV set it is not possible to receive the satellite signals.

What are the vertical bars, seen at the beginning of a colour transmission, required for?

These are the 'colour bars'. They contain black, white and six colour bars, totalling eight bars. With the help of the bars and the colour control in your set, you can make sure that all the colours are reproduced properly.

Which are these colours, and are they in any particular order?

The colours are white, yellow, green, magenta, red, blue and black. White is the brightest, yellow is the next, while blue and black are the last in terms of brightness. In television language, these are arranged in their order of 'luminance'.

Are there only eight colours possible then?

No! Television's primary colours are red blue and green. Other colours are produced by a combination of these three in various proportions. These are called primary colours. When red is absent, with the combination of blue and green we get cyan or bluish green. Hence cyan is known as a complementary of red. Similarly, magenta (bluish red) is the complementary of green. Also yellow (greenish red) is the complementary of blue.

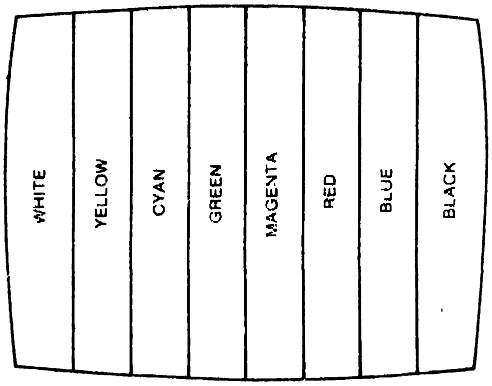

Fig. 5

In a TV camera the light from the image is split up into three primary colours by colour filters and sent to three separate camera tubes. The voltage outputs of these cameras are manipulated to obtain the actual colour voltages. These voltages modulate three separate beams in the receiver which fall on three adjacent coloured phosphor dots. The dots are so close that eye sees the total colour produced and not the individual dots.

By going close to the screen, we can see the separate colour dots in older sets and colour stripes in modern sets.

How are colours arranged in the rainbow?

The colours in a rainbow are arranged according to their frequencies as the colour splitting is done by a frequency based phenomenon known as refraction.

The frequencies of various colours in the rainbow are thousands of megahertz and cannot be thought of in television. In TV the colour becomes a voltage in the tube, remains a voltage throughout and impinges on the phosphor as a voltage controlled electron beam. Colour is produced only at the screen because of the chemical nature of certain phosphors which emit certain colours when an electron beam falls on them. Hence colour frequencies, as known in physics, have nothing to do with this electronic system.

How do these colour bars appear on black-and-white sets?

They appear as various shades of grey. White is the brightest bar, yellow is next, and so on thus presenting a grey scale gradation. The actual adjustment of contrast and brightness are to be done not with this but with a ten-step grey scale included in another test chart.

Are these colour bars produced by focussing the camera on a colour chart?

No! These are produced electronically. As stated in another answer, the colour is produced by certain voltages and these voltages can be accurately produced by electronic circuits.

In fact many TV cameras themselves have colour bar generators in their circuitry. Colour bar generators are also available as separate instruments. □

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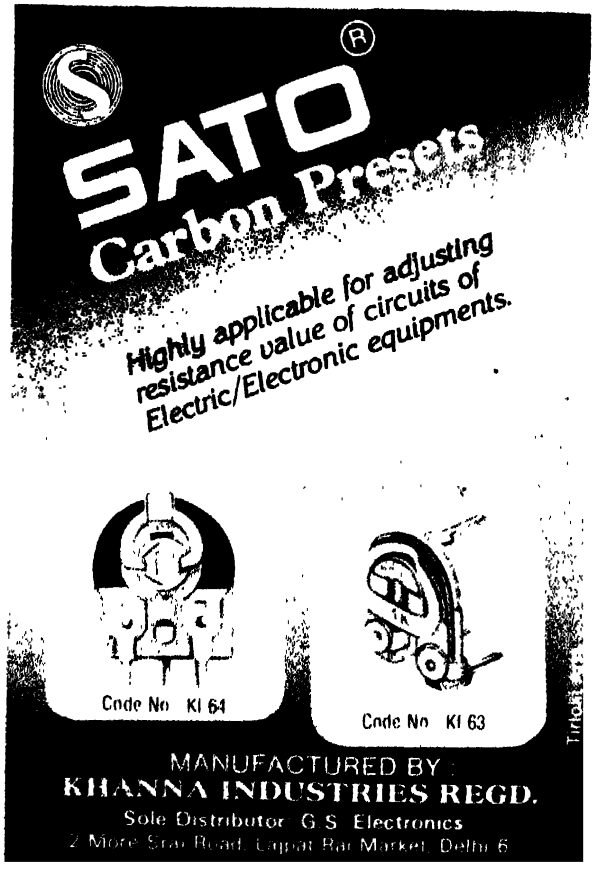
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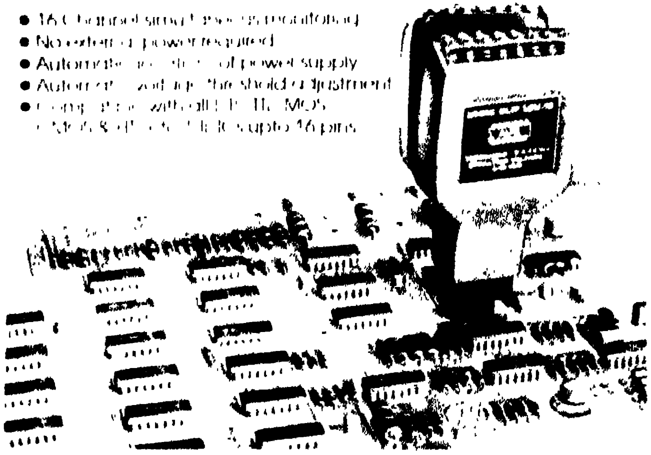

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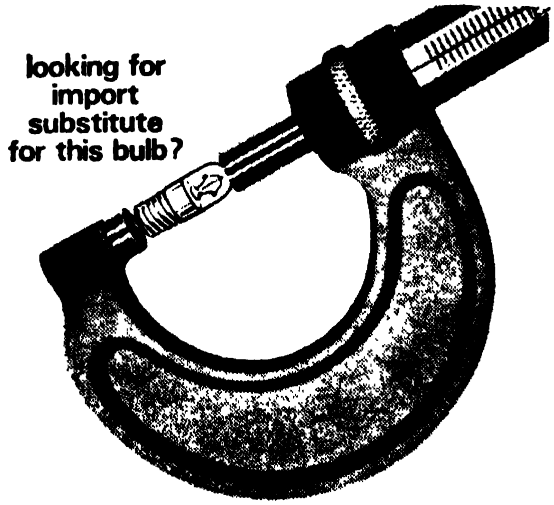

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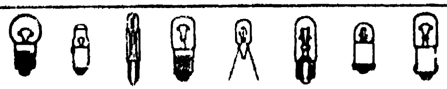

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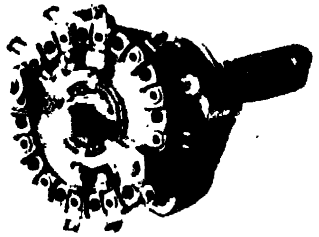

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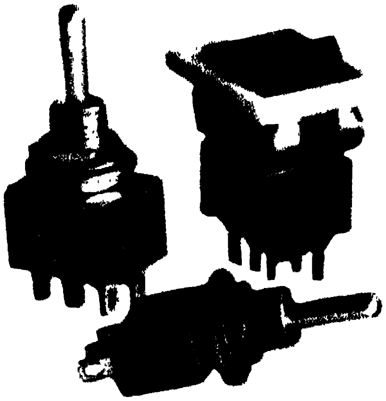

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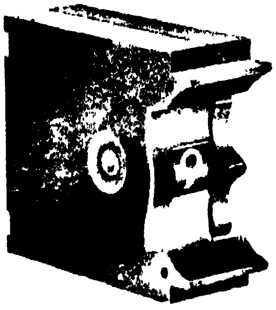

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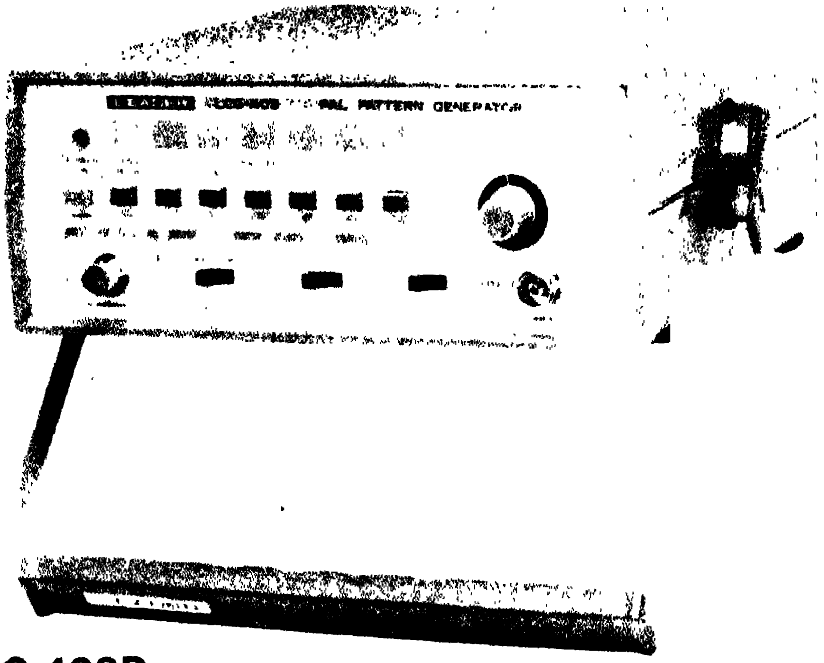

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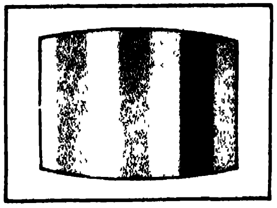
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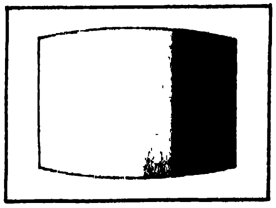
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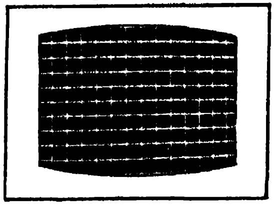
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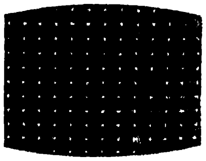
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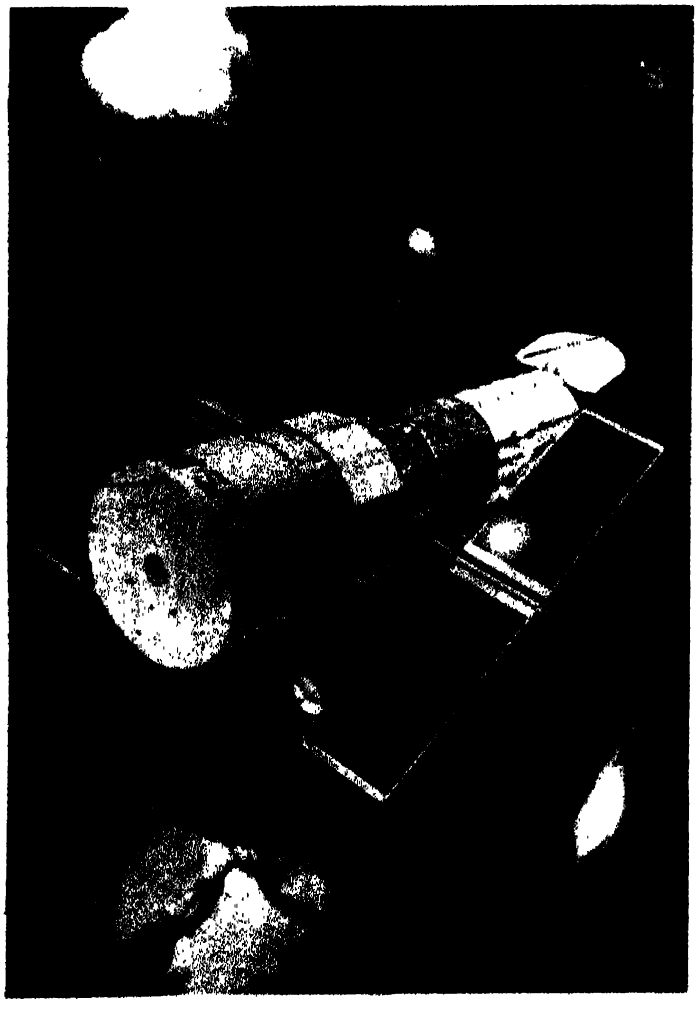
Characteristics of Fixed Satellite Service

Part II



Based on an ITU (International Telecommunication Union) report.

Various networks in the FSS are used by more than one administration on a common basis to satisfy their domestic and/or international communication services.

A particular example of such a user system is the INTELSAT system. Other examples of common user systems are INTERSPUTNIK, ARABSAT, PALAPA and EUTELSAT.

INTELSAT provides satellite communication services to all nations on a non-discriminatory basis. At the end of 1984, the space segment consisted of 15 satellites and the earth segment consisted of a total of about 850 earth sation antennae including about 300 international and nearly 550 domestic antennae in more that 160 countries, territories and dependencies. The international service provided more than 36,000 full-time voice and data circuits and over 49,000 half-channel hours of television transmissions. Allotments amounting to some 40 transponders were leased to 27 nations for domestic communications. The most recent INTELSAT satellites use approximately 500 MHz of spectrum for up-links and down-links in both the 6/4 GHz and the 14/11 GHz FSS bands.

Let us take a look at certain special issues which are of relevance to common-user systems.

Service arc considerations. The choice of orbital locations for a common-user system may be more constrained by the geographical locations of the various users of the system than would be the case for some national systems. The choice of orbital locations for a satellite system which must have the capability to connect all users in a given region is limited by the need to provide visibility at satisfactory angles of elevation for earth stations at the edge of the coverage area.

In the Atlantic region for INTELSAT, for example, the location of the Primary Path satellite cannot be varied by more than 1.5° without reducing the elevation angle of the limiting earth stations to less than 5°, i.e. the minimum for satisfactory operation in the 6/4 GHz band. In the Indian and Pacific Ocean regions, the service arc for the Primary Path satellite is only 3° wide.

Space station coverage considerations. The size of satellite antenna beam coverage may also be affected by the geographic extent of the user administrations. The largest such beam would occur in systems providing service on a global basis. In such a case, a beam which covers all countries served by the common user system, whether global or regional, is particularly useful for TV distribution services, in which several widely dispersed earth stations which are not located in other coverage beams require simultaneous reception of a certain telecast. Such beams can also provide connectivity for widely distributed, thin-route earth stations throughout the service area and the trend is to limit the bandwidth required for use in such beams to the minimum.

Earth station technology and operational characteristics

The most important earth station technologies in vogue are those associated with antenna characteristics and transmitter/receiver techniques. These factors affect the satellite network characteristics, and some of them have much to do with the efficiency of utilisation of the geostationary satellite orbit/spectrum.

Antenna characteristics. The most relevant earth station element, amongst those mentioned above, is the antenna sub-system. Two important performance parameters of an earth station antenna—side-lobe and polarisation--have a direct effect on orbit utilisation.

The most important space station technologies are those associated with antenna characteristics and transponder components. These factors affect the satellite network characteristics and also contribute to the efficiency of utilisation of the geostationary-satellite orbit/spectrum.

The antennae used in most earth stations are of the axi-symmetric Cassegrain type. For this type of antenna, the effect of blockage and diffraction due to the sub-reflector and its supports results in increased side-lobe levels. Nevertheless, many antennae now in use have improved side-lobe performance, particularly those with D/λ greater than 150. There are also new small asymmetric type antennae that are being installed with better side-lobe performance.

Polarisation characteristics. Polarisation discrimination depends on the polariser characteristics and the surface accuracy of the main and sub-reflectors, the former being the major contributor. A typical value of polarisation discrimination required for current earth station antennae is 30 dB (axial ratio of approximately 0.5 dB for circular polarisation) and earth station antennae with polarisation discrimination of more than 30 dB are currently feasible. On the other hand, improvement in polarisation discrimination beyond a certain threshold (approximately 30 dB), while feasible, does not result in a significant increase in capacity. This is the case, for example, of small-sized earth stations with low traffic requirements, that usually have reduced polarisation-isolation performance.

High power amplifiers (HPAs). Klystrons and travelling wave tubes (TWTs) are used at present for earth station HPAs. Though the signal bandwidths of klystrons are about 40 MHz to 80 MHz, a band of 500 MHz can be covered by tuning the cavity in the 6, 14 or 30 GHz bands. Regarding the maximum saturated output power, klystrons of 14 kW in the 6 GHz band, 3 kW in the 14 GHz band and 500 W in the 30 GHz band have been developed. TWTs have signal band widths of 500 MHz in the 6, 14 and 30 GHz frequency bands respectively and do not require tuning. Regarding the maximum saturated output power, TWTs of 14 kW in the 6 GHz band, 3 kW in the 14 GHz band and 700 W in the 30 GHz band have been developed.

To reduce the level of intermodulation products produced in the HPA for multi-carrier operation, a lineariser of the pre-distortion type has been developed and used in some earth stations. By using such a lineariser, the level of intermodulation products will be reduced by more than 10 dB in the range of output back-off equal to or larger than about 6 dB.

Receiver techniques

Use of a receiver chain with a low system noise temperature at an earth station is an essential requirement in a satellite communication system. The receiving system noise temperature is mostly determined by the noise contribution of the antenna and the first stage amplifier. At present, parametric amplifiers either cooled by gaseous helium or thermoelectric devices or at ambient temperature are.in use. Low noise amplifiers (LNAs) using gallium arsenide field effect transistors (FET) have been developed.

Space station technology

The most important space station technologies are those associated with antenna characteristics and transponder components. These factors affect the satellite network characteristics and also contribute to the efficiency of utilisation of the geostationary-satellite orbit/spectrum. In particular, satellite antenna technology provides the major technique for increased frequency reuse from a single orbit location, whether on the same satellite or on different satellites.

Antenna technology. While spot beam antennae provide for more frequency reuse of a given bandwidth, this is limited by the need for coverage and by the separation of the covered areas. Shaped beam technology offers some possibilities to enhance the application of spot beam technology for a wide variety of requirements.

Shaped beam antennae offer the potential for improved side-lobe control, particularly where the coverage area itself is rather large thus improving the possibility of frequency reuse between coverage areas close to each other. However, it should be noted that discrimination beyond-the-edge-of coverage is function of satellite antenna dimensions. Launch vehicle constraints may be a factor here. Some present launch vehicles can accept a solid antenna with dimensions of up to 3.8 metres approximately.

The orbital positions of existing satellites may have to change to accommodate new satellite systems. To cope with this situation, space station antennae would have to be designed to take this fact into account. The direction of the radiation patterns would probably have to be changeable by control from the ground. In some cases, it may be desirable to re-shape beams in service in order to allow for a large change of location. However, the cost and operational impact of introducing such capabilities has not been sufficiently studied.

Transponder components. Since the introduction of communication satellites, there has been continuous improvement in the EIRP. The higher EIRP levels translate into higher down-link C/N (carrier/noise) and correspondingly increased channel capacity, for a given size of earth station. A domestic satellite concentrates its radiated power onto a single country, and generally achieves a higher EIRP than an international system with global or large area coverage, for the same size TWTA. In addition, these higher EIRP levels result from the use of higher power amplifiers in the satellites.

Solidstate devices such as FETs are generally less efficient than TWTs as power amplifiers but provide better linearity than TWTs. Thus, higher capacity may be achievable for multiple access systems because of better carrier-to-intermodulation ratios.

Multiple access and modulation techniques

Multiple access and modulation techniques are interrelated. These techniques affect the bandwidth efficiency of systems.

Multiple access is the technique which enables respective transmission links of a large number of earth stations to be interconnected through the same satellite. This technique is essential to exploit the unique geometric properties of wide-area visibility and multiple connectively which are the features of satellite communication systems.

Multiple access techniques can be classified into preassigned multiple access system and demand assigned multiple access system in respect of circuit utilisation. In the former system, the channels required among earth stations are assigned permanently. In the latter system, the channels are assigned to the stations only on occasion of demand and satellite channels are therefore shared amongst users in time.

Moreover, multiple access techniques can be classified into frequency division multiple access system (FDMA), time division multiple access system (TDMA) and code division multiple access system (CDMA).

In FDMA, the usual practice is pre-assigned multiple access, therefore carrier frequencies are assigned exclusively to each earth station and multiple carriers of different frequencies share a common satellite repeater. Such a multiple carrier operation always results in less capacity being available as compared to the single access mode due to the power back-off which is required to reduce the level of intermodulation products. The base modulation techniques associated with FDMA can be either single sideband AM, frequency modulation or various digital modulations such as 2-PSK or 4-PSK.

The orbital positions of existing satellites may have to change to accommodate new satellite systems. To cope with this situation, space station antennae would have to be designed to take this fact into account.

In TDMA, a carrier of the same frequency is shared by multiple stations on the basis of non-overlapping (in time) burst transmissions through a satellite repeater. From the viewpoint of traffic, a TDMA system has greater flexibility than an FDMA system.

The CDMA system is one where signals occupy the same location in both the frequency domain and the time domain, but can be distinguished from others by proper signal processing. Spread spectrum multiple access (SSMA) is one example of a CDMA. The SSMA makes use of a deterministic noise-like signal structure to spread the narrow band information over a relatively wide band of frequencies. The spectrum spreading is achieved by modulating each signal by a unique code, so that demodulation of a wanted signal can be done by means of correlation detection in which signals having different codes will not be correlated.

Modulation techniques. From the viewpoint of the efficient utilisation of the geostationary-satellite orbit/spectrum, it is desirable to adopt bandwidth efficient modulation methods. The modulation methods which are widely used in current satellite communication systems are frequency modulation (FM) and phase shift keying (PSK). Recent developments include the use of the singleside band-amplitude modulation (SSB-AM) in conjunction with compandors. The SSB-AM provides a high-density analogue modulation alternative to digital systems. The development of highly stable, solidstate linear amplifiers for satellite transponders has given boost to this technique.

PSK modulation uses digital signals which requires analogue-to-digital conversion for voice. The resulting digital signal is processed and coded usually into 64k bit/s per channel. The PSK can be accomplished using any number of phase pairs to distinuguish the binary state. Theoretically, 4-PSK requires the same power, but half the bandwidth per bit, as compared to 2-PSK for a given link performance. Higher order (greater than 4-phase) PSK systems are more susceptible to noise and, therefore, need more power than either 2- or 4-phase systems to achieve the same standard of performance. Although a decrease in the number of phases permits closer satellite spacing, the utilisation of the GSO tends to be optimised wh. .he number of phases is in the range of 4 to 8 and the orbit utilisation efficiency tends to decrease as either a higher or a lower number of phases are utilised.

Other digital modulation techniques, amplitude-shift keying (ASK), frequency-shift keying (FSK) and composite modulation techniques involving both amplitude and phase-shift keying have been studied. Of these techniques, ASK and hybrid techniques involving ASK are not appropriate to TDMA because the transponder non-linearities and.power-efficiency effects usually constrain the modulation format to have a constant envelope. In the case of FDMA, the use of ASK and hybrid techniques involving ASK is also restricted because of its greater sensitivity to co-channel interference.

Recently, new modulation techniques used in RF domain such as minimal shift keying (MSK) and tamed frequency modulation (TFM), in which the envelopes of modulated carriers are constant, have been studied. Since these modulation techniques are desirable for future systems, further studies are required. Also of importance are baseband and channel modulation techniques. In digital systems, it is possible to use 32k bit/s modulation and work on 16k bit/s appears promising. It is also possible to gain another factor of two to three in capacity using digital speech interpolation (DSI) in conjunction with any of the above modulation techniques.

Another common technique in use in satellite communication systems is single-channel-per-carrier (SCPC) on selected transponders for use with low-capacity earth stations. Typically PCM (digital) or companded FM (analogue) equipment is used to modulate a single voice transmission, but delta modulation 2-PSK as 4-PSK units are also in service. SCPC type carriers are also in operation for medium speed data (56k bit/s) and audio distribution.

In satellite video transmissions, FM with frame-rate energy dispersal is typical. The baseband may include multiple audio/data sub-carriers. Techniques are under development for dual television signal transmission through interframe interleaving of independent video signals. Such techniques will allow a single satellite transponder to support two independent television transmissions with a quality comparable to today's single television transmission per transponder.

Some trends in system characteristics

Several other factors will have a significant impact on the changes that can be expected in the future of FSS characteristics affecting orbital utilisation.

Traffic growth. FSS system characteristics are probably most affected by the growth in traffic volume carried over the system, the changing pattern of this traffic, and the introduction of new services. Initial loading may consist of a relatively few high-density links between major traffic centres. In time, additional links may be established to lower density traffic centres and thin-route services provided to remote locations. Moreover, demand for services may be greatly stimulated by the availability of high-quality communication facilities at a given location.

Once earth stations are installed to provide basic services to a community, it is also relatively easy and economical to expand the range of services provided. Such additional services might include video and audio programme distribution and data services.

It is often more economical for a country to initially lease capacity in an existing, larger capacity satellite. Eventually, traffic may grow to the point where a dedicated satellite is economically justified. Where several nearby countries have been leasing capacity on a global satellite system, such a dedicated satellite system might initially take the form of a regional system, rather than individual national systems, to reduce space segment costs. It is expected that each system will have its own unique pattern of development over time.

Integrated services digital networks. With the rapid growth in international and national digital services, satellite systems are expected to play an increasingly important role. The CCIR is developing a recommendation which discusses the necessary satellite performance characteristics to meet the CCITT, integrated services digital network (ISDN) objectives. Satellite systems which are expected to provide channels for an ISDN should take these performance objectives into account.

Modulation type and transmission parameters. Changing traffic volumes and patterns, as well as the introduction of new services and types of earth stations, can be expected to affect the types of modulation and carrier transmission parameters associated with the FSS system. These changes may result in transmissions having greater or lesser susceptibility to interference and greater or lesser potential to cause interference. For example, as traffic grows on high-traffic density links, it is usually more economical to increase the RF carrier capacity by use of more bandwidth efficient modulation techniques than to allocate additional transponders. In addition, SCPC-FDMA transponder configurations are common as lower density, thin-route locations are added to the FSS network. However, low capacity TDMA systems are also under development where several such systems may access a transponder in an FDMA mode.

Trend to limited coverage and beam shaping. Spot beams on space stations in the FSS increase satellite G/T and EIRP and permit frequency reuse. The use of narrow antenna beams that concentrate gain over the coverage area helps to reduce the earth segment costs and increase satellite capacity.

Such spot beams are becoming almost universal for national coverage FSS systems. When coupled with fast roll-off characteristics of side-lobes, a substantial increase in orbit utilisation can be achieved. This is because the orbital separation between narrow-beam satellites serving non-overlapping coverage areas can be reduced due to the satellite antenna discrimination. With sufficiently distant coverage areas and/or fast enough roll-off characteristics, such satellites could be located at the same nominal orbit locations; the risk of collision is remote.

The use of spot beams covering different portions of a satellite's service area can also lead to greater orbit utilisation. The spatial isolation between narrow beams permits frequency reuse at the orbital location. In addition, advances in satellite antenna design technology permit shaping of the satellite antenna beam. Such shaping may be used to adapt the contours of the antenna beams to better fit the required coverage areas.

Increase in EIRP and sensitivity. There is a distinct trend towards increased satellite EIRP and decreased space station and earth station receiver noise temperatures. This trend tends to encourage increased transponder capacity and lower cost earth stations. Also, the trend towards higher EIRP satellites may also be used to improve orbit utilisation by permitting an increase for all FSS systems in the portion of the noise budget allocated to interference from other satellite systems.

Trend towards bandwidth limited and interference limited operation. In many systems, one satellite may be required to serve an increasing number of earth stations. The ability of a single satellite to satisfy such growing requirements may be limited by the bandwidth available in the satellite. In the case of satellites using multiple spot beams for frequency reuse, available capacity may also be limited by interference levels between the various spot beams.

Expansion bands. While little use has been made of the new bands in the 6/4 and 14/11 GHz ranges, it can be expected that they will be of increasing value in the future as requirements continue to increase. The propagation conditions which will be experienced in the new bands in the 6 and 4 GHz region result in the same transmission environment as the conventional 6 and 4 GHz bands. This will allow new systems using these bands to employ designs for both spacecraft and earth stations essentially identical to current systems.

Systems using the new bands around 14/11 GHz will be essentially identical to those currently in use in the conventional bands at 14/11 GHz. The additional 500 MHz that is available for both up- and down-links can provide the same capacities as achieved by current systems since the transmission environment is the same. No significant cost impact is expected for new systems.

Higher frequency bands. FSS systems will increasingly use the higher frequency bands for a number of reasons. First, the addition of higher frequency bands to an FSS system may be more economically and technically attractive than more intensive frequency reuse techniques. In addition, increasing orbital congestion in the lower frequency bands will also lead to the use of the higher bands. In particular, the greater antenna directivities available at the higher frequencies will permit smaller satellite spacings and thus a greater number of satellites to be accommodated. Consideration of terrestrial interference may also lead to an increasing use of higher frequency bands, especially if terrestrial systems are not highly developed in the higher bands. Finally, the higher frequency bands tend to have higher bandwidths, e.g. 3500 MHz of bandwidth is available between 17 and 31 GHz. □

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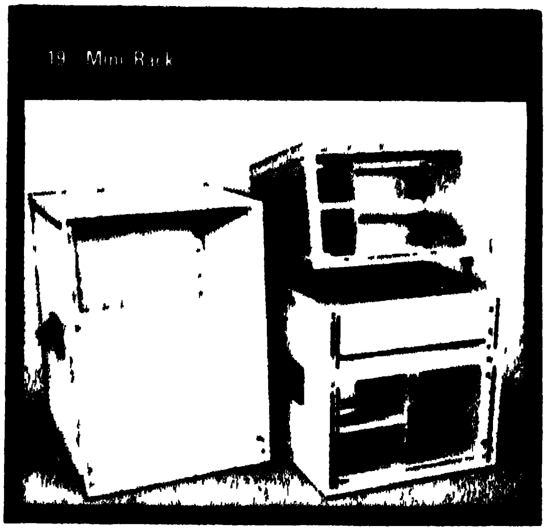

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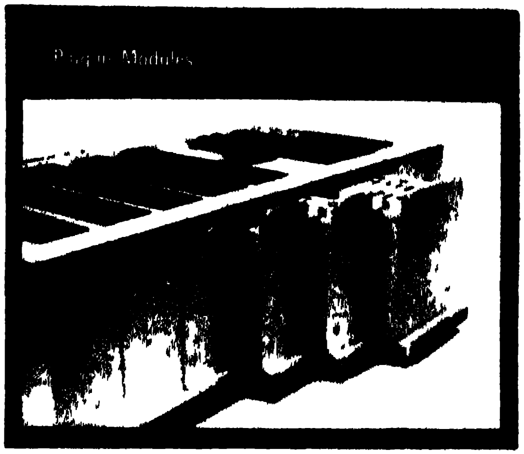

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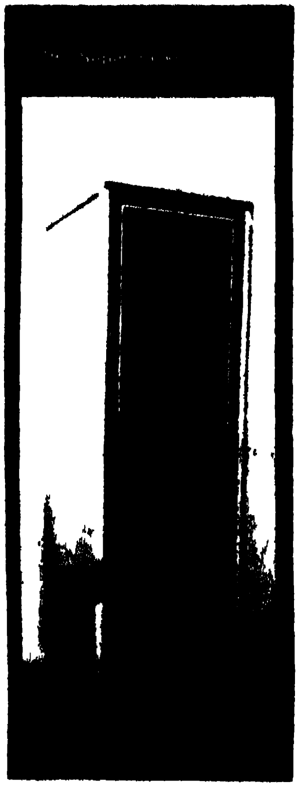

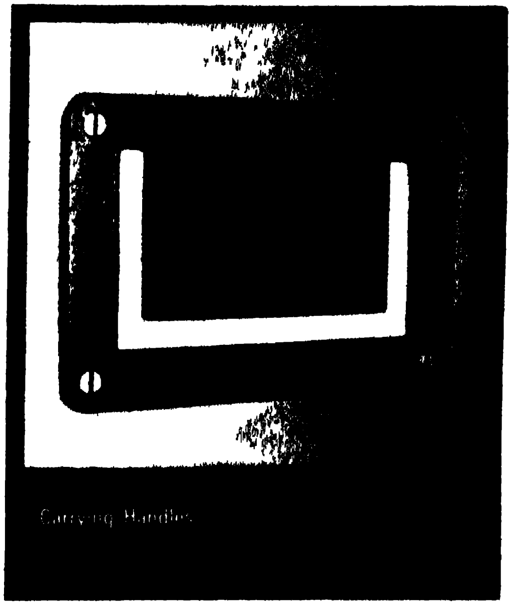

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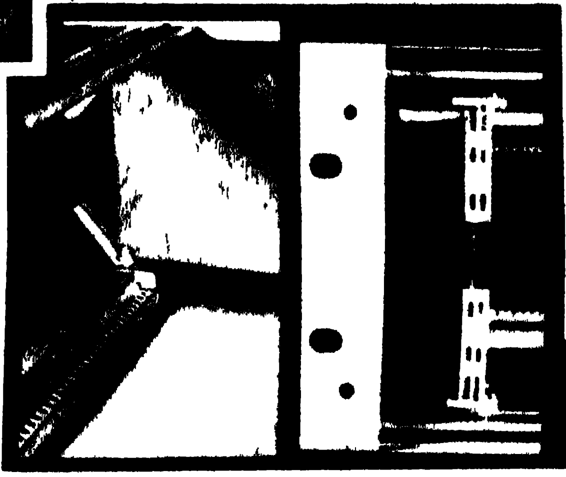

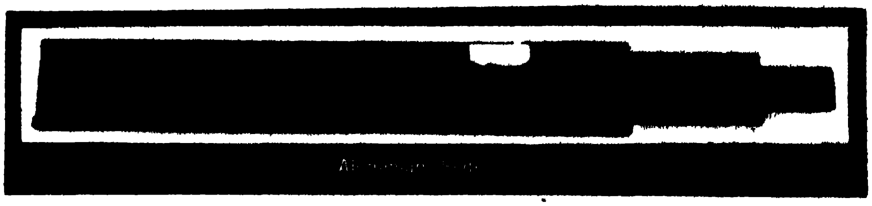

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Behind the Portable Power Sources

Part II

A.V. Jacob

Hermetically sealed lead-acid batteries are unquestionably superior in applications like portable TV sets, video-audio cassette recorders and professional cameras. At a moderate current level, their size specification is much better than the dry cell versions. These can be easily and repeatedly recharged to a specific full charge level. Another added advantage is their ability to retain charge for long quiescent periods without any over-charging problems. They can remain in an overcharged state for weeks together without changing their basic features.

Though the process of charging is usually simple and straightforward, in the case of lead-acid cells it is advisable to follow some guidelines to ensure a long life. For a fully discharged lead-acid cell, it is ideal to charge it at 0.1C up to 60 per cent of its voltage and then increase to 0.25C till it reaches 120 per cent of its voltage level. Further, the charging rate is reduced to below 0.01C until the voltage reaches the maximum possible level. For a 12-volt pack, the first phase of charging ends at around 10 volts, the second phase around 14 volts, with the final phase converging at 16.5 volts.

Self-regulating chargers are extremely useful in lead-acid batteries especially where prolonged voltage or charge levels of the cells may not be possible. One of the popular circuits used is as shown in Fig. 8. As soon as the system is activated, SCR S1 will jump into a state of conduction thus commencing the process of charging with an appreciably high current. The battery combination can either be of three cells giving 6 volts or six cells giving 12 volts. Diode D1 conducts for each half of the input voltage, supplying more charge current to the batteries. As the potential increases, the diode combination D2 conducts, instantly putting off SCR S1. This action will be repeated whenever the battery voltage falls below the threshold value. The rest of the time, there is an effective

TABLE V
Typical Operating Conditions of Commonly Used Instruments

Device	Internal resistance (ohms)	Usage hrs/day	Volume/Power Density	Cutoff Voltage	Service Life wrt NiCd (hours) first	second
Pacemakers	2000	24	7×10^{-1}	0.9		
Watches	1800	24	8×10^{-2}	0.8	–	–
Hearing aids	300	12	5	0.9	275	250
Mini receivers	75	4	0.5	0.9	66	60
Medium receivers	39	4	8	0.9	42	28
Tape recorders	10	1	3	1.0	4.5	3.9
Cassette players	6.8	1	20	1.0	3.5	2.9
Calculator LEDs	15	0.5	6	0.9	14	12
Calculator LEDs Programmable	5.6	1	20	1.0	2.5	1.8
Portable lighting	5	5 min	25	1.0	4.4	3.8
Toys	3.9	1	40	1.0	3.2	2.9
Portable TVs	3.3	2	60	1.0	1.8	1.2
Movie cameras	2.8	1	65	1.0	0.7	0.5

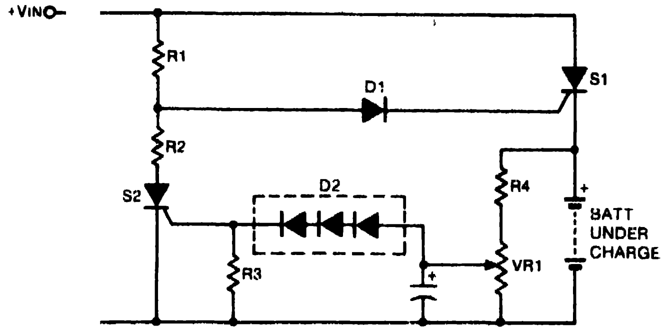

Fig. 8: Lead-acid battery charger.

trickle charging effect by which the cells can always be ready for use.

Multifunction devices

Devices nowadays are loaded with a host of functions and incredible versatility. It is axiomatic that more the functions of the device, more exasperating is the circuit and its powering methods. Portable light-weight devices often warrant regulated or unregulated negative power supplies along with the usual positive supplies. Extra batteries will naturally increase the weight.

One of the basic approaches to derive negative supply from the existing positive supply is demonstrated in Fig. 9. It makes use of an oscillator of a convenient duty cycle and frequency. Its output is rectified and filtered, and if necessary regulated to a convenient voltage level. A certain amount of loss is expected in this manoeuvre. The circuit shown in Fig. 9 uses 50 per cent duty cycle at a frequency of around 7kHz. This can provide a negative supply up to 10 mA without much change in the output voltage.

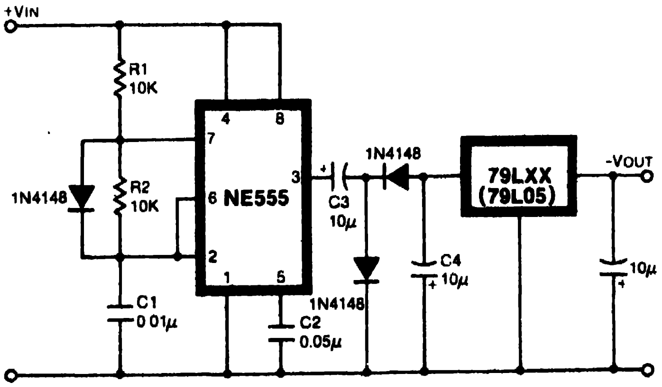

Fig. 9: DC-DC negative converter.

A more economical solution to the problem of powering op-amps from a low voltage/capacity battery is the use of DC-DC converters. As a rule, op-amps consume small amounts of current. If the current drain from any power supply is very low and if the time constant of the filter network is sufficiently large, only a small ripple will be present in the output of the supply. A complete bipolar supply regulated at both ends and derived from a small battery of very low capacity and size is shown in Fig. 10. The approach here is similar to that of the circuit in Fig. 9, with a combination of positive supply. The timer is made to oscillate at around 10 kHz with a duty cycle of about 75 per cent. The transistor is switched at this rate, producing negative as well as positive pulses at the secondary of the transformer and the collector of the transistor. These are rectified, filtered and then regulated. The supply shows a very high stability at low currents.

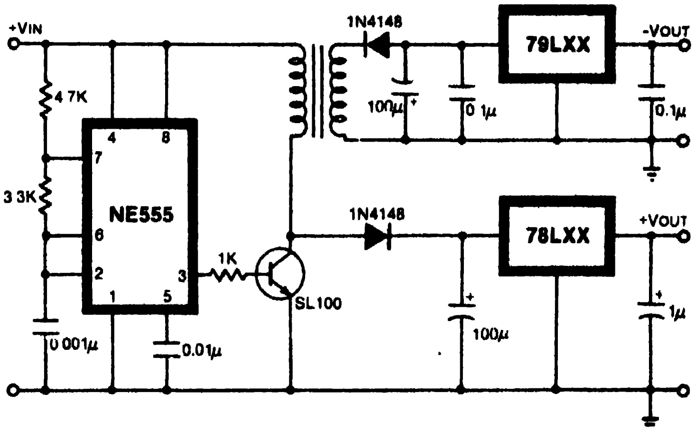

Fig. 10: DC-DC dual converter.

Fourier analysis of the waveform generated by converters reveals the presence of significantly high-order harmonic components. These harmonics can be troublesome to the high-gain op-amps used in critical stages as well as a source of radio-frequency interference to AM or FM tuners. A convenient switching rate has to be selected in such a way that the harmonics will not directly interfere with the normal operation of the device and can be notch-filtered if they arise to a menacing level at any stage of the supply.

Batteries for portable photographic devices

The electrical or electronic support to the realm of photography started sometime in 1844 with the advent of arc lamp projection microscope by Foucoult. Fox-Talbot wizardry in spark photography reported in 1851, appraised the beneficial applications of electricity in photography. By 1893, electrical ignition of flash powder helped expanding under-

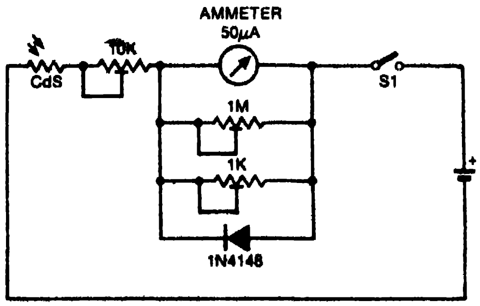

Fig. 11: Typical light intensity meter in camera.

water photography. The electronic flash designed by Edgerton and Laporte in the 1920s marked all the possible vistas in photography. Through the miracles of silicon technology, a complete camera of the size of an index finger loaded with complex lens combinations, view finders, light meters, batteries and flash guns are now available. The circuit for a typical light intensity meter in a camera is shown in Fig. 11.

Photo sensors, photosensitive switches, colour, temperature and flash meters, electronic shutters, focussing devices, remote control devices and related integrated photometric devices need reliable power sources. A good part of commercial electronic products and range of batteries are solely meant for use with the portable photographic devices. As Table VI indicates, almost all professional and semi-professional cameras rely on the silver oxide sources. They compare favourably with mercury cells in many respects except that the cell voltage is 1.5 volts. They have a very good shelf life and a capacity of 50 to 750 mAH. Application of integrated meter circuits along with silicon or gallium photodiodes are primarily aimed at the reduction of power consumption along with heightened accuracy in every measurement and subsequent operations.

TABLE VI
Practical Camera Sensors and Their Power Sources

Brand	Model	Sensor	Power Source	Voltage
Nikon	FE	Silicon diode	Silver oxide	1.5×2
Olympus	OM-2N	Si diode+Cd sulphide	Silver oxide	1.5×2
Minolta	XG9	Cadmium sulphide	Silver oxide	1.5×2
Pentax	ME sup	Gallium diode	Silver oxide	1.5×2
Canon	A1	Si diode	Silver oxide	6 volts
Fujica	AX-5	Si diode	Silver oxide	6 volts
Konica	FS-1	GaAsP	Alkaline maganese	1.5×4

Solar power sources

To date, the ultimate source of energy, the sun, is used effectively only in satellites. Mammoth solar cell arrays in space provide the necessary energy for the satellites for several years. However, the use of solar power replacing conventional chemical energy in terrestrial instruments is disproportionately small. The major drawback with most solar cells is that the potential they provide is limited to around 0.5 volt. This means that eight to ten cells are required to operate a simple radio. The standard size cell (53mm × 6.3mm) may be able to supply around 4 mA. Moreover, a majority of the cells have a structure of silicon diodes with conversion efficiency of 8 to 15 per cent.

Some solar panels manufactured presently can deliver a power of 10W at a solar irradiation level of 1kW m^{-2} into a load resistance of 20 ohms. But the enormous size and variability of its capacity prevents its widespread application. Each solar cell has a safe operating area limit (SOAL) which is another disadvantage. The present trend is to employ solar panels along with a storage battery pack like NiCds, so that the working equipment can draw power during over-cast days and night, when the arrays receive little or no energy. The solar sources charge the storage batteries whenever the solar cells are irradiated. Presently, calculators and wrist watches make abundant use of this technique.

Basically, solar cell can be considered as an extended form of silicon p-n junction diode. The junction barrier potential Vj is around 0.7 volts just as in the silicon diode (Fig. 12). The contacts share this potential as V1 and V2 if no light falls on the junction. Typically, V1 is around 0.5 volt. The rest will be developed across the n-region as V2. An ideal voltmeter connected across the contacts can measure only zero potential in the absence of irradiation. If the junction is exposed to radiation, electron-hole pairs are generated due to the field of Vj, making them move across the junction. Consequently, Vj falls in proportion to the intensity of irradiation. Now V1 rises to the maximum, say, 0.6 volts and V2 cancels with Vj. The p-contact potential V1 will provide the positive terminal for the external load.

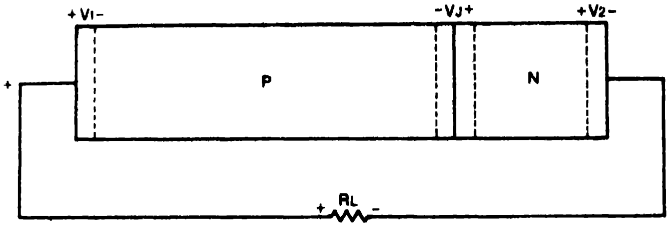

Fig. 12: Construction of a solar cell.

In low-voltage, high-current applications, the cells are arranged in parallel to each other to counteract the source resistance. Alternatively, a series combination is preferred for a low-current, high-voltage application. Usually a trade-off is adopted between the series and parallel combination of cells to make them suitable for real-life situations.

In order to utilise the maximum available power output of solar cells, they are carefully selected and matched with respect to the open circuit voltage, short-circuit current and the maximum power point. The cells which are connected in series and parallel have the same current and voltage respectively at the maximum power output (Fig. 13). The power obtained from the cell is the product of the current through the solar cell and its terminal voltage.

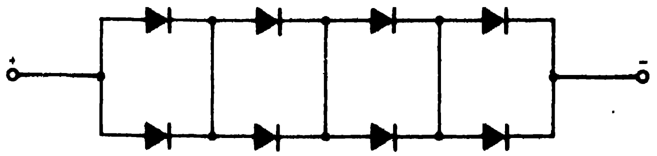

Fig. 13: Series and parallel combinations of solar cells.

The SB-250 series of solar cells from Stotron Ltd, UK, has a convenient dimension of 15cm × 8.5cm × 0.5cm which is

TABLE VII
Comparison of Zinc-Carbon and Nickel-Cadmium Performance

Load Current at 1.45 volts mA	Discharge period per day, hours	Zinc-Carbon				Nickel-Cadmium			
		Hours to reach a terminal voltage of							
		1.1	1.0	0.9	0.8	1.1	1.0	0.9	0.8
300	0.5	12	17	20	21	8	10	12	15
300	2	5	8	13	15	4.6	7.6	12	14.6
100	2	40	55	60	65	20	26	31	36
25	2	230	240	245	250	234	246	251	267
25	4	240	255	275	290	230	258	273	289
100	4	30	38	45	55	30	38	44	50
25	12	150	190	210	250	175	211	238	270

Note:

1. Ambient temperature 28°C.
2. Numbers are aggregates, tested with products from two different manufacturers.
3. Purely resistive load.

suitable for calculators and other hand-held instruments. These can be arranged in series or parallel to charge a set of NiCd batteries in a portable unit or to drive the load directly. For example, SB-2508A gives 8 volts at 95 mA and an open circuit potential of 11 volts, while SB-250-2 gives 2 volts at 500 mA and an open circuit potential of 2.5 volts. These are comparatively light (150 grams), with an energy density of 600 Wm^{-2}, on a sunny day in tropical areas.

National Semiconductors has introduced mini-packs of hermetically-sealed solar cells of TO-18 and TO-5 outline. These have a good stability, high efficiency and excellent short-circuit current linearity over a wide range of illumination. These are presently used for both power generation and light sensing applications, especially at low light levels, mainly due to their fast response time which is around 8 µs. The operating temperature range is about -60°C to +125°C. All these devices can be irradiated using a lens combination for excellent power generation.

The typical voltage that most solar cells generate in sunlight is 0.45 volt. However, in practical cases the number of solar cells required for an application is obtained by $n = Vo/0.4$. The circuit given in Fig. 14 uses two SB-250-08A cells in series but can be replaced by 40 solar cells in series, the latter being rather difficult to obtain. The current capacity of solar cells is determined by the load current, the length of time the cells are exposed to light, the duration of usage and the amount of rest time between the usage. Depending on the brightness of the sunlight, the cells can deliver 16 or more volts, while the minimum charge potential for a NiCd is around 1.35 volts. While designing the solar charger, the effects of cloudy or hazy days must be compensated for. Since diodes D1 and D2 are of equal type, the entire PD from the solar cells is developed across the zener diode. The output of the battery is then fixed using a three-terminal regulator.

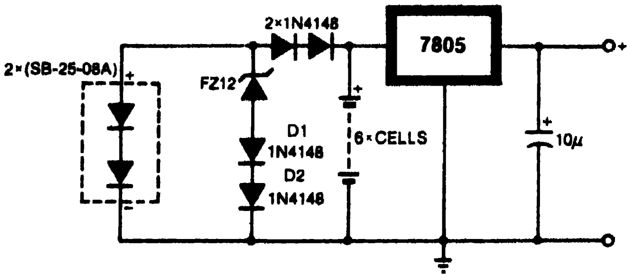

Fig. 14: Solar cell charger.

Portable solar power sources are mainly used in calculators, wrist watches, mini radios, light meters and toys. Specially designed integrated circuits like ZN415 (from Ferranti Semiconductors, UK) can operate from 1.5 volts consuming a maximum power of 120 mW. An 8-pin DIL IC, ZN415 consists of an RF tuner and a two-stage amplifier covering a frequency range of 150 kHz to 3 MHz which is enough for medium- and long-wave reception. A simple solar-powered receiver using ZN415 is shown in Fig. 15. This receiver delivers about 1.5 mW at 1 volt into a load of 64 ohms.

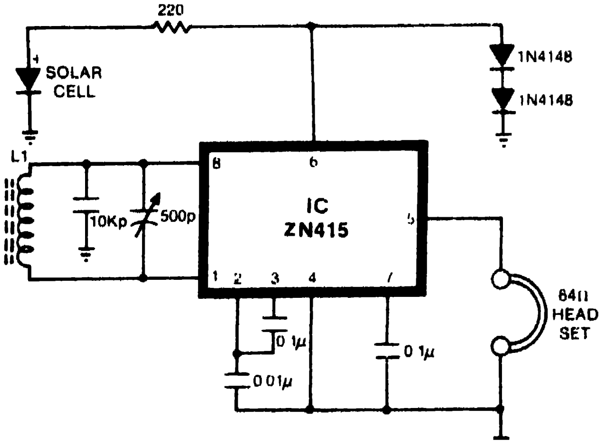

Fig. 15: Typical solar cell radio.

Alternate sources

All trends indicate that leading manufacturers are considering the possibilities of alternate portable power sources like thermoelectric and atomic batteries. In thermoelectric cells, the principle of thermocouples is employed but the

THE SUN HAS PLAYED TRUANT FOR THE THIRD DAY IN SUCCESSION

metal poles are replaced by n and p type semiconductors. Heat energy can be applied to the junctions by mini-burners made out of gas or petrol or both. It may then resemble a cigarette lighter with piezoelectric sparkers concealed in a suitable enclosure. The idea looks elegant but its practicality still remains to be seen.

Frenetic attempts have been made to convert radioactive energy directly into electrical energy in a capsule form, but only a bleak note has surfaced so far. Atomic batteries are supposed to have an outline similar to that of thermoelectric batteries, where thermal energy is produced by the decay of radioactive isotopes like Strontium-90. So far, Strontium-90 is the only contender in this field mainly due to the fact that its half-life is around 28 years. At present, such devices are used in unattended installations like clandestine transmitters and transponders in desolate high-altitude regions. Its availability for common use is not expected in the immediate future.

The alarm over the growing poisoning due to mercury and lithium batteries has been increasing for some time now. There is also evidence that the poisoning is real, that it is growing, and that it may reach an alarming proportion if nothing is done to alleviate it. Yet, the available experimental evidence on chronic human health effects due to mercury cell sources is limited and inconclusive. At present, one can neither unambiguously demonstrate the existence of effects nor disprove their existence.

Lithium presents formidable safety hazards because of its high activity level. To top it all, lithium chloride is readily soluble in many organic compounds which human beings tend to use. In extremely low concentration, the same lithium is not only considered harmless but inevitable for many reactions. Lithium cells are often packaged as miniature button cells so that it is hard to recover from the waste dumps for reprocessing or safe deposition. However, substantial research efforts are now under way on this issue, and a solution should emerge soon. □

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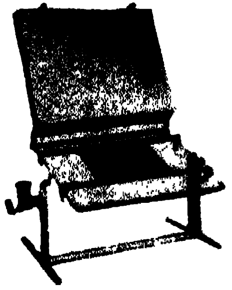
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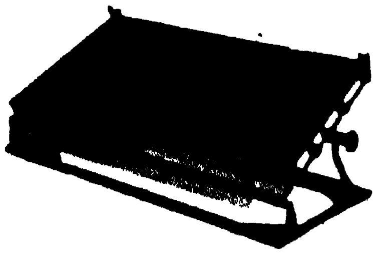
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Model		Max. PCB
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IS 3	ISFL 3	200 x 300
IS 4	ISFL 4	325 x 550

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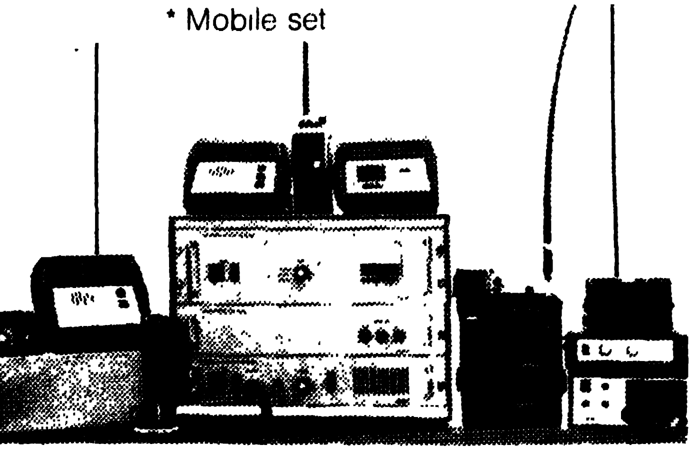

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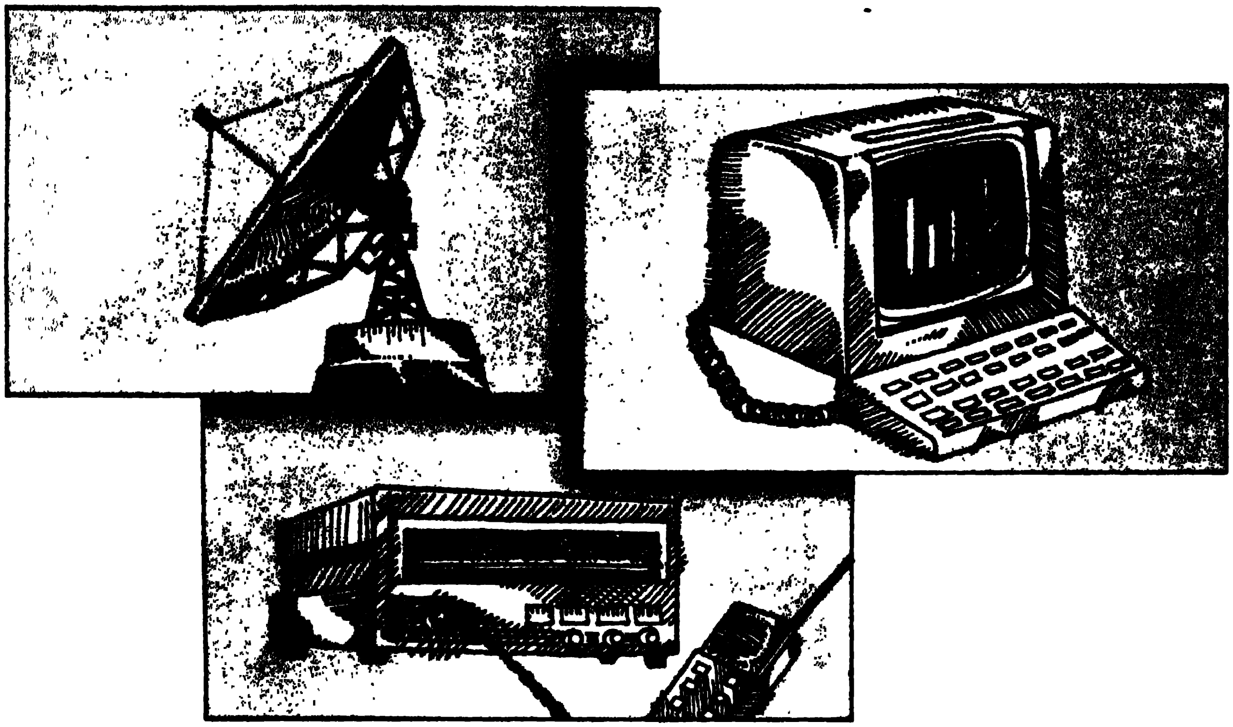

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Computer Corner

Computer production and imports

The number of microcomputers and other small computers reported to have been manufactured and sold in India during the period 1980-85 are:

Year	*Quantity*
1980	*365*
1981	*751*
1982	*1198*
1983	*1279*
1984	*3385*
1985	*7185*

The government has given clearances for the import of computer systems either in whole or in parts worth Rs 2495.8 million in foreign exchange during 1983-85, as per the following details:

Year	*Value [in Rs million]*
1983	*182.7*
1984	*803.1*
1985	*1510.0*

The foreign exchange outlay for imports of parts during the period 1980-85 was about Rs 1210 million. The year-wise details are as follows:

Year	*Value [in Rs million]*
1980	*92*
1981	*108*
1982	*139*
1983	*195*
1984	*212*
1985	*465*

This information was given by Mr Shivraj V. Patil, the minister of state for Science and Technology, and Departments of Atomic Energy, Electronics, Ocean Development and Space, in response to a couple of questions raised in the Lok Sabha by Mr Ajit Kumar Saha, MP, on April 16.

Foreign collaboration to manufacture computers

The Indian government has not approved any foreign collaboration proposal for manufacture of 32-megabyte computers although two proposals for manufacture of computers having word length of 32 bits and above with foreign collaboration have been considered.

ECIL [Electronics Corporation of India Ltd, Hyderabad] proposes to manufacture mainframe computers [word length 60 bits] in collaboration with Control Data Indo-Asia Company of USA and manufacture super minicomputers [word length 32 bits] in collaboration with Norsk Data AS of Norway. In both these cases no foreign equity participation is envisaged.

The programme with Control Data covers the manufacture of Cyber 180/810 and 830 range of systems, and ECIL has proposed to manufacture about 350 such systems over the next five years.

The proposal with Norsk Data covers the manufacture of ND 530/550/560 and 570 range of systems, and ECIL has proposed to manufacture 250 such systems over the next five years.

This information was given in a written reply in Lok Sabha by the minister of state for Science and Technology, Mr Shivraj V. Patil.

Quickest personal-computer code sort

A British company believes it has developed the world's fastest machine code sort for the IBM personal-computer, capable of sorting 1000 items in one second.

The utility is written in true 8088 assembler code and is 100 per cent compatible with the 8088, 8086 and 80286 family of computers, including all IBM clones tested so far.

It permits compiled or interpretative BASIC applications to sort large files extremely quickly—effectively introducing a sort command to BASIC. File input procedures are left up to the user, permitting optimum performance by the user's application software. The constraints are the maximum amount of memory available or the upper limit of the operating system.

The manufacturer can modify the original source code to interface into other languages, such as COBOL or C, for example. The machine code itself is very compact, occupying less than 500 bytes, and is completely self-relocating. The original source code is available to software houses who wish to integrate the utility into their own existing program codes.

Although most sorts suffer severe deterioration in performance as the amount of data increases, this sort is almost linear in its response times, and it is said to be ideal for sorting large amounts of data. In theory, it could sort an entire telephone directory of 200,000 names in just under five minutes using an AT.

Unlike many sorts which slow down when data are already presorted, this sort is 250 per cent faster when the arrays are pre-sorted.

[Contact: PC Utilities, 20 Laxey Road, Horfield, Bristol, England BS7 0JA.]

New LANs for the office

The possibility of linking different systems and terminal devices for text, graphics and data processing to centralised communications and storage systems on a flexible basis is attracting increasing attention in the field of office communications. Two new LAN [local area

network] components developed by Siemens [W. Germany]—an electrical Cheapernet [thin Ethernet] and an optical CSMA/CD network—will have an important role to play in this development.

The new Cheapernet LAN is particularly suited to the establishment of highly flexible networks to connect personal computers and workstation systems. With its full compatibility and modest price, it is the ideal supplement to the standard Ethernet. The cost of the new network is up to one-third less, depending on the configuration. The transmission medium used is a thin coaxial cable [0.6 cm]. The largest segment is 185 m long, serving 30 connections. The connection range extends to 2.1 km and a total of 1024 connections are possible per network.

A further innovation in the in-house network sector is the optical CSMA/CD network. Compared with the copper coaxial cable, the graded index fibre offers numerous advantages. Due to the physical properties of the optical waveguide, the optical LAN is formed with a star-shaped structure. The terminals are connected to an active star-type coupler with 32 connections via optical transreceivers. The star-type couplers are interconnected on up to five levels. The maximum extent of the optical network is up to 5 km in the case of a single-level configuration and up to 3.5 km in the case of five levels. It thus exceeds the range of electrical networks considerably.

Software import and indigenous development

In regard to software for computers for database management or wordprocessing, or for similar packages, foreign exchange to the tune of Rs 173.2 million has been reported to be spent during 1980-85.

Some of the popular brand names of the database management software developed indigenously are IMPRESS, SOFT PRO and SOFT BASE and those of wordprocessing software are SOFT PRO, SOFT WORD, WORDLORD and SHABDMALA.

The software has been marketed along with the indigenous systems all over the country. The average price of the database software on microcomputer systems is about Rs 2000 and that for wordprocessing software is about Rs 1200.

These indigenous products have not yet made a breakthrough in the overseas market.

This information was given recently by Mr Shivraj V. Patil, minister of state for Electronics, in reply to a question from a member of Parliament in the Lok Sabha.

Qualified manpower for computers

In order to reduce the gap of availability of technically qualified computer personnel, the Department of Electronics has initiated a number of programmes jointly with UGC, Ministry of Human Resource Development and the Directorate General of Employment and Training.

But the provision of an educational base to produce technically qualified computer personnel is faced with two major constraints, namely, [i] shortage of qualified and experienced teachers, and [ii] long gestation period of training.

However, at present the estimated number of technically qualified and experienced manpower available in this field with a degree or diploma is 3000. In addition, there are about 2000 persons who have learnt computers as part of their curriculum in other disciplines.

The Department of Electronics is also considering the participation of public and private sector organisations in meeting part of the requirement, especially at the lower level of computer education.

More British computers for US

GEC Avionics, a British company, has won its second order to provide the United States Navy and Air Force aircraft with computers to give pilots information on speed and height. The company has secured a £ 38 million contract for standard central air data computers [SCADC]. Last year it won contracts totalling £ 100 million to supply head-up displays for fighter aircraft made by the US company General Dynamics. These units enable pilots to operate at low altitudes at night.

This follows the award last June of an order worth over £ 23 million for SCADCs and raises the total number of units to be supplied to the two forces to nearly 3000.

The computers will be installed in about 30 types of aircraft, including fighters, early warning and electronic counter-measures aircraft, and the giant Lockheed C-5 Galaxy transporter.

Mastering your IBM PC

Mastering Your IBM PC, a series of seminars, is intended for supervisory staff, office managers, administrators, small business owners and users—the people who are expected to understand the IBM PC's wide range of capabilities and meet the demand to get more work done in less time.

This comprehensive two days' course, which will be run July 4-5 at Kuala Lumpur, July 7-8 at Singapore and July 10-11 at Hong Kong responds to the needs of today's busy information-using professional. Practicals, plain language lectures and real life examples combine to focus on using the PC to enhance business functions and systems. Key areas including data security, software copyright and expansion opportunities will also be covered in depth.

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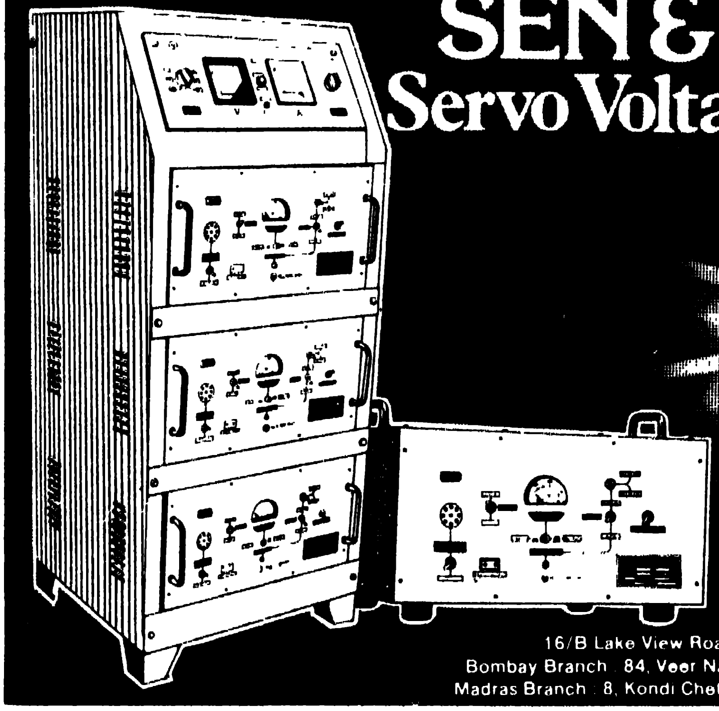

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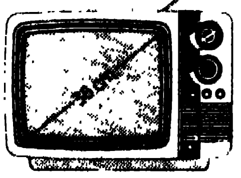

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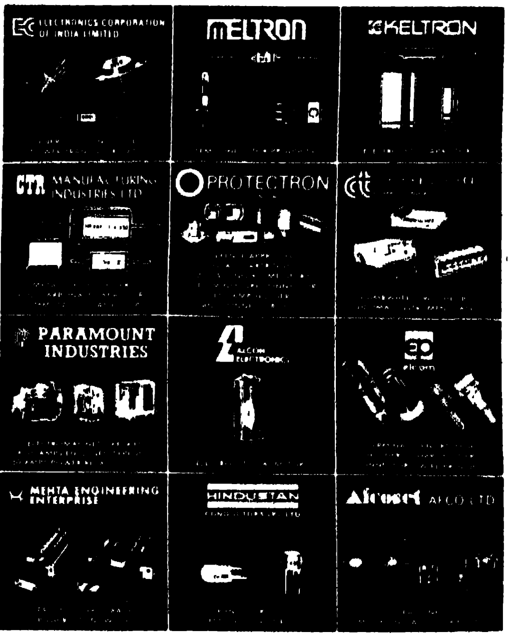
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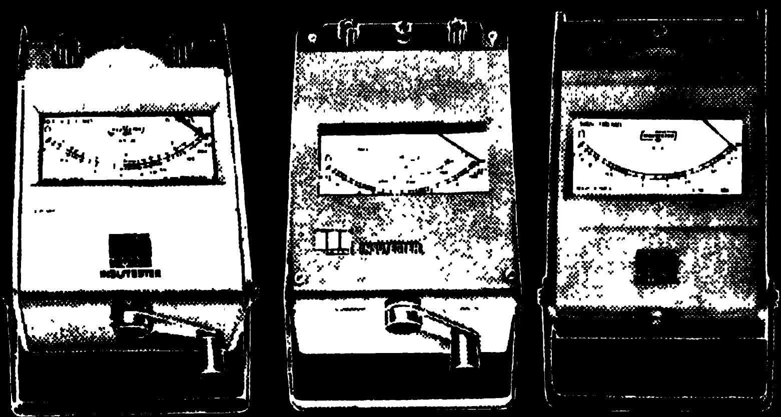

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Computer Aided Testing

R. Radhakrishna Warrier

Tests came into existence when man turned to tool-making. Ever since they have occupied a place of prominence in the process that starts with man's imagination and ends in a practical working tool. As the tools grew in complexity and sophistication the tests too grew correspondingly so. Finally, man found it convenient to entrust the process of testing to a very powerful tool of his—the computer. Thus computer aided testing, or CAT, came into vogue.

Tests began to be automated long before the computer appeared on the testing scene. Automatic control of the test process dates back to the period immediately following the Second World War. Developments in complex weapon systems, followed by massive advances in the aerospace technology, created many new test problems. Conventional manual testing was found inadequate to meet the complexity, volume and speed required. The rapidly advancing electronics technology offered a solution to this problem in the form of automatic test equipment, or ATE.

CAT and ATE

ATE in its simplest form consisted of equipment that were controlled by instructions stored in tapes or punched cards. The tests were limited to non-branching, sequential operations with no data storage or computing facility.

The range of ATE was considerably extended when the computer was used as the source of instructions. This used to be referred to as computer controlled ATE. The ATE became much more powerful when the computer not only acted as the central control but also participated in data management, computations, measurement analysis and test signal synthesis. This came to be known as computer based ATE.

Thus, in test automation, the computer and the automatic test equipment play complementary roles. The term CAT is applied when the computer plays a significant role in performing a test.

Why do we use CAT?

We use CAT to maximise test performance in the form of any or all of the following: Higher speed, better accuracy, increased repeatability, reduced human fatigue, increased human creativity, thoroughness and cost effectiveness. Speed, endurance and accuracy are the watchwords of CAT.

Tests are an essential part of R&D, manufacturing, or operation and maintenance. The importance of testing is now well recognised and due attention is paid to improve its performance. Hence CAT is being introduced not only where manual testing is impossible or difficult but in all situations where its introduction leads to optimum results.

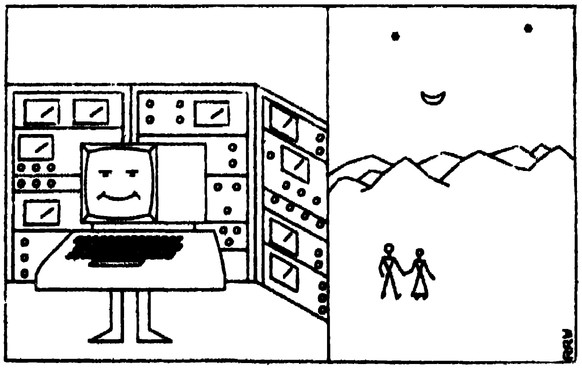

Fig. 1: Man found it convenient to entrust complex tests to the computer...

The use of CAT has become widespread because the hardware is now widely available at competitive prices. Thanks to the advances in electronics technology, an

---

Mr Warrier belongs to the Test & Evaluation Division of Vikram Sarabhai Space Centre, ISRO in Trivandrum. It may interest the readers to know that he drew the accompanying illustrations using a computer controlled plotter.

reasing number of equipment are incorporating ATE capability at decreasing costs. Many equipment now feature the ability to be easily interfaced to a computer through standard interfaces. The computer too has become more powerful and less costly than before. It has found popular acceptance in the form of 'personal' and 'desk-top' computers, many of which are powerful enough to be used in CAT applications.

Test functions

To understand CAT let us have a close look at the test process. A test process, be it manual or automatic, essentially consists of applying certain stimulii to the unit under test (UUT, also referred to as the device under test, DUT), and obtaining the response of the UUT to these stimulii. A test system (i.e. the collection of physical devices that perform the test) would therefore consist of the UUT, the devices that apply the stimulii, the devices that measure or suitably convert the form of the response, and suitable hardware for appropriately routing the stimulii and response.

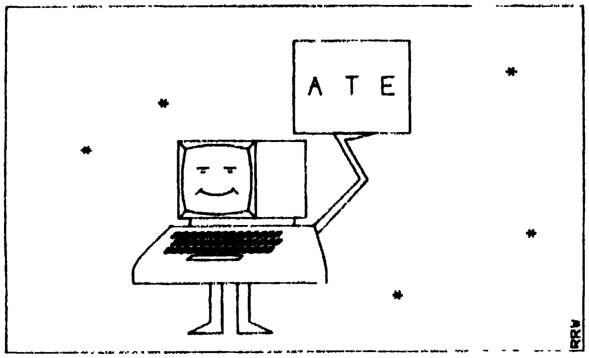

Fig. 2: The computer and the ATE play complementary roles in test automation.

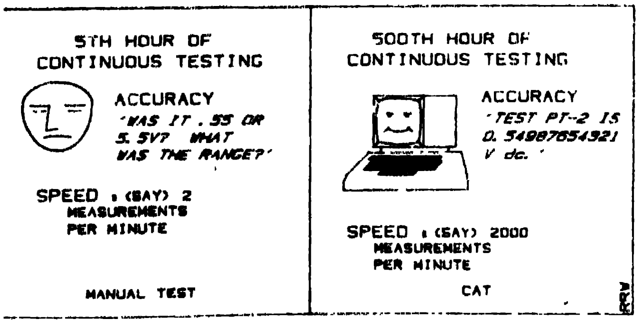
5TH HOUR OF CONTINUOUS TESTING
ACCURACY
'WAS IT .55 OR 5.5V? WHAT WAS THE RANGE?'
SPEED : (SAY) 2 MEASUREMENTS PER MINUTE
MANUAL TEST
500TH HOUR OF CONTINUOUS TESTING
ACCURACY
'TEST PT-2 IS 0.54987654321 V dc.'
SPEED : (SAY) 2000 MEASUREMENTS PER MINUTE
CAT
RRV

Fig. 3: Speed endurance and accuracy are the watchwords of CAT.

In addition to these, a very important component of the test system is the 'system controller' vested with the responsibility of the overall management of the test process. The roles of the system controllers in the manual and the CAT systems are shown in Fig. 5. The system controller essentially coordinates and implements the various functions involved in carrying out the test. These test functions are given below:

Control. This involves controlling the functions and states of the system devices. In other words, it is modifying, as required in the test sequence, the mode, operation, configuration or connection of any of the equipment in the test system, including the UUT.

Data acquisition and management. This is gathering, formatting, classifying and recording in a suitable form all the necessary information that lead to the test results.

Computation and analysis. This refers to the mathematical operations performed on the raw data to convert them to more meaningful pieces of information.

Sequence and timing. This involves deciding 'what next' and 'when' of the operations of the test. Decision is the essence of this function.

Implementation of test functions

In manual test the human is the system controller. The human operator interacts with the system through eyes, ears, hands etc. With these sensory and mechanical apparatus the operator converts his or her cerebral processes into physical implementation of the test functions. In CAT, the computer serves as the system controller, assuming the functions previously performed by the human operator. Let us see how the computer implements the test functions.

To begin with, the human cerebral processes involved in performing a test are replaced by the equivalent but faster and more accurate processes inside the central processing unit (CPU) of the computer. These processes are nothing but the tremendously fast manipulations of digital electronic information in the form of bits, bytes and words.

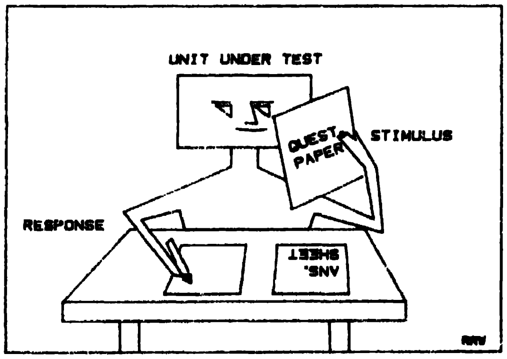

Fig. 4: The unit under 'test'.

There is nothing intelligent or smart about a computer. It is the programming skill coupled with the speed, accuracy and endurance of the computer that makes it appear smart. The computer has to be provided with detailed step-by-step instructions on how to carry out the test under all the expected conditions. This is programming or the software part of CAT. The computer can be programmed to simulate the cerebral processes involved in activities such as decision making, control, computation, classification (indexing) etc.

Control and communication

In a manual test an operator performs a control function by, say, turning the knob of a power supply to set it at a desired voltage level; acquires data by connecting a multime-

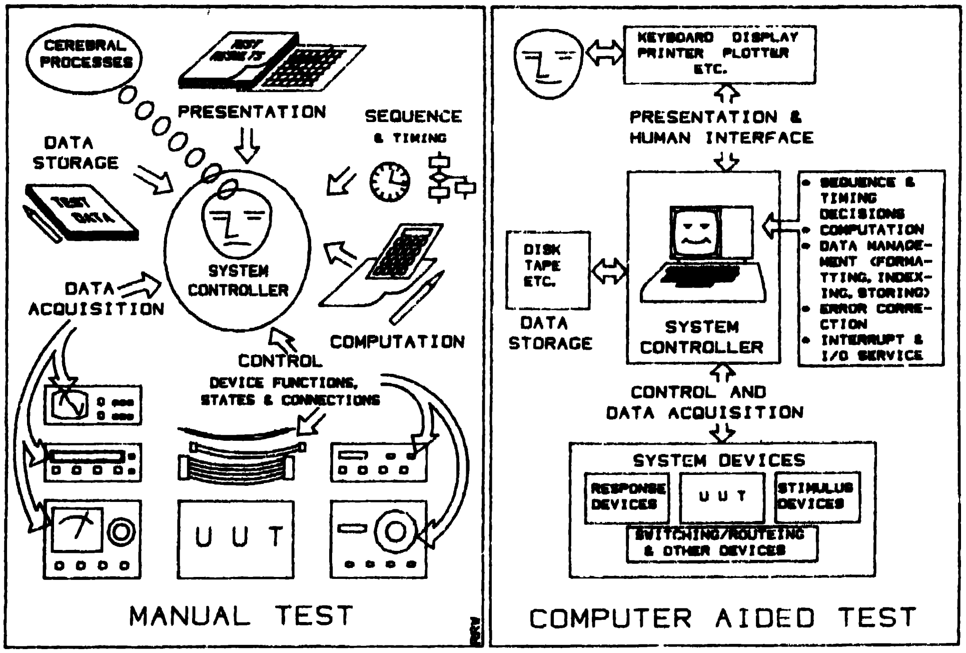

Fig. 5: The system controller has the responsibility of the overall management of the test.

ter to different test points and noting the dial indication; alters the test set-up configuration by introducing or disconnecting some equipment. How will the computer implement these functions which were dependent on the human sensory and mechanical capabilities?

The computer itself obviously cannot turn a knob. By itself, it can neither come to know of what is happening in the outside world nor affect any control over these happenings. As mentioned earlier, the computer is only a manipulator of digital electronic information. Hence the outside information has to be presented to it in that form. Similarly, its output signals have to be converted to real world events to affect computer control.

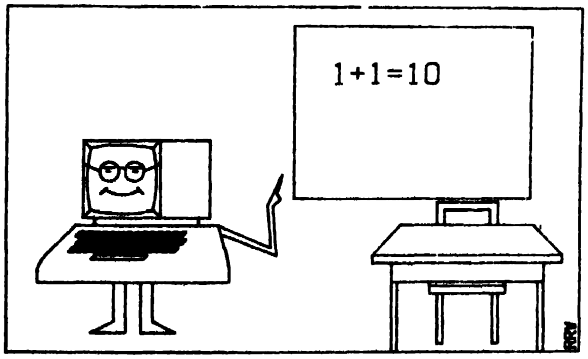

Fig. 6: The computer is merely a tremendously fast manipulator of binary digits represented electronically.

This brings to our attention two important requirements of CAT. First, the test equipment should be electronically controllable. The power supply in our example should be settable to the desired voltage levels through appropriate electronic command signals. Secondly, equipment such as the multimeter should be able to 'talk', i.e. communicate data information through electronic means.

These requirements imply that the equipment should incorporate suitable hardware to (i) implement electronic control of their device functions, and (ii) make them capable of exchanging control and data information electronically. A communication link is now implied together with its protocol for the management and interpretation of the exchanged information. The hardware, the communication link and the protocol taken together are collectively known as the interface. The interface becomes the common thread that binds the components of the CAT system. In such a set-up, control or data acquisition reduces to a matter of appropriate programming.

To avoid a 'Babel Tower' in the ATE field certain interface standards have been internationally adopted. A widely used interface is the general-purpose interface bus (GPIB), based on IEEE 488 interface standards, utilising multiwire bus communication for fast and comprehensive information exchange. The RS 232 serial interface is another well adopted interface for communication over longer distances than is possible with GPIB.

Programmable interconnections

In our manual example, the multimeter was connected to and disconnected from the various test points. The set-up was altered by connecting or disconnecting some equipment. In CAT these requirements can be met by using some form of programmable switches. To automate the scanning of test points by the multimeter, we can use programmable multiplexers or scanners. These consist of a number of input channels, any one of which can be connected to a common output under program control —as shown highly simplified

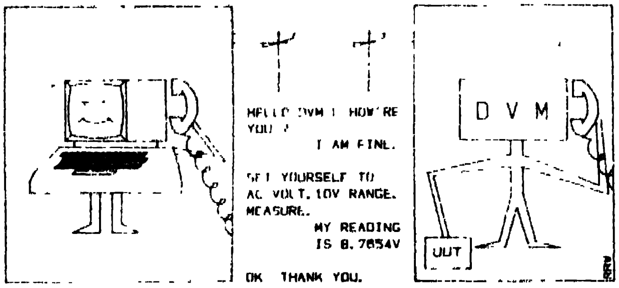
HELLO DVM ! HOW'RE YOU ?
I AM FINE.
SET YOURSELF TO AC VOLT. 10V RANGE. MEASURE.
MY READING IS 8.7654V
OK THANK YOU.
D V M
UUT

Fig. 7: In CAT, the system devices should be able to communicate and should be controllable through electronic means.

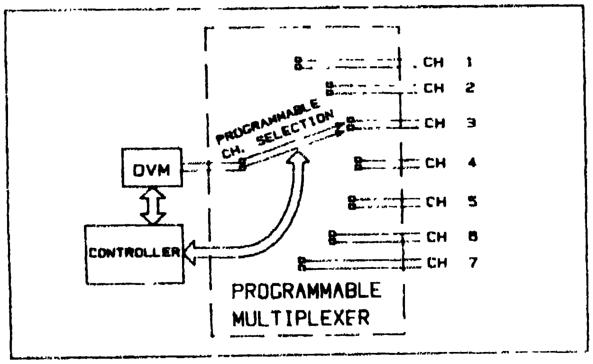

Fig. 8: Data acquisition using a programmable analogue multiplexer and a DVM.

in Fig. 8. For altering the test set-up and re-routing stimulus and response signals, appropriate programmable switches and switching networks or switching matrices can be used

Data acquisition

The computer acquires data and measurement results through the interface controlled measuring devices. Data are sometimes acquired directly through I/O ports of the computer, when presented after suitable processing including analogue to digital (A/D) conversion. In some cases, real world responses such as temperature, pressure, vibration, rotation, etc are presented to measuring devices after conversion to electrical signals using transducers such as thermistors, thermocouples, pressure guages, vibration pick-ups, tachometers etc. Software techniques are generally adopted to compensate for the non-linearities or other peculiarities of these transducers.

In Fig. 8 we came across a method of analogue data acquisition using a DVM and a programmable scanner. Various 'data acquisition systems' and 'data loggers' are available that perform many input-output (I/O) and control functions besides data acquisition. These are multiplexing, switching, A/D and D/A conversion, pulse and pulse train generation, timer, pulse and frequency counting etc. Fig. 9 shows a typical data acquisition system.

CPU functions

The CPU determines the sequence of the test operations based on the program presented to it. The CPU can be programmed to take decisions on alternate courses of action based on some results of its operations (conditional branching) or some external events (interrupt). The operations can be timed using internal or external real-time clocks.

The CPU carries out the mathematical operations required to perform the computation and analysis function. It also performs data processing operations such as formatting the data, classifying or indexing them, and managing their storage. The data may reside in the volatile memory of the computer or may be stored more permanently in discs or tapes, as required.

In manual testing the human operator is able to handle unforeseen conditions such as errors or malfunctions of the system devices. In CAT, the program has to clearly instruct the CPU on handling contingencies and error recovery.

Data presentation and human interface

The human and the computer interact through the computer 'terminals'. The human can input information to the computer through the keyboard and similar devices. The computer communicates to the human through printers, plotters, video display units etc.

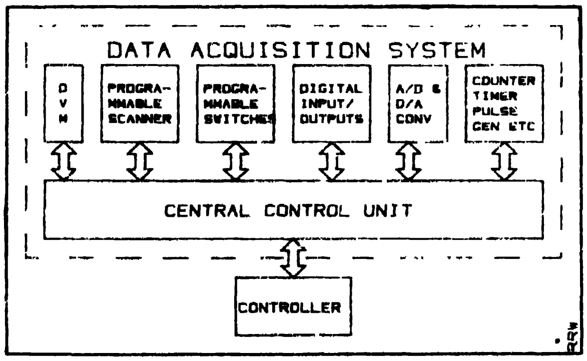

Fig. 9: A typical data acquisition system.

The computer may be programmed to output the test results through any of these. The data presentation can take the form of printouts, graphical plots, displays, or any combination of these.

The CAT set-up

A typical CAT set-up is shown in Fig. 10. The actual configuration may be much simpler or more complex, depending on the test requirements. Nevertheless, the set-up should be capable of performing all the functions we have outlined here.

Concluding remarks

This article briefly dealt with some fundamental technical aspects of CAT. It may be remarked now that a potentially large demand exists in India for indigenously made equipment that can be interfaced to the computer. Manufacturing concerns, process industries, R&D organisations all need interface controlled equipment.

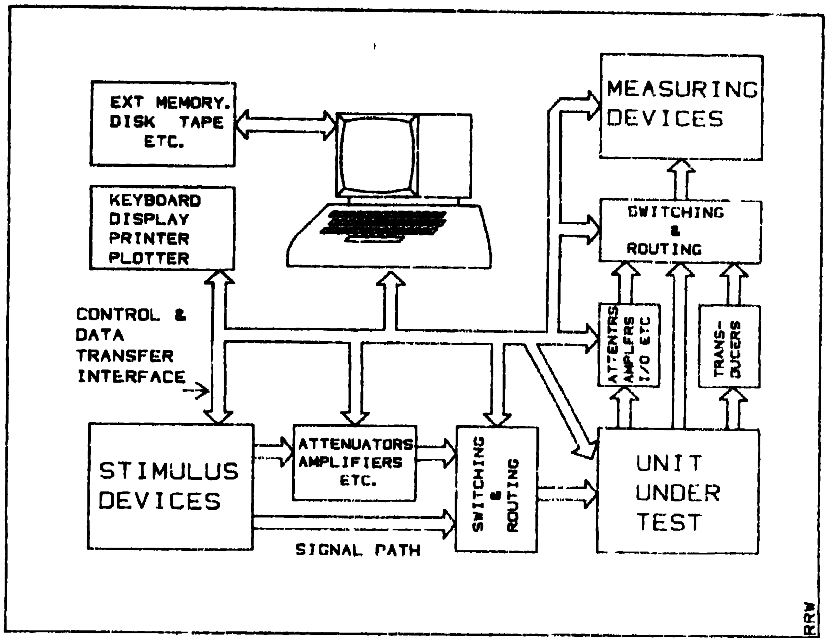

Fig. 10: A typical CAT set-up.

The present requirement is met through imports. Equipment manufacturers in India have not given much attention till now to incorporate the interface capability, even in relatively simple pieces of equipment such as power supplies or DVMs.

Now that the computer industry in India has entered a stage of vigorous activity, we expect that computers would be in wide use in the near future. It is high time that due attention is given to computer based instrumentation. □

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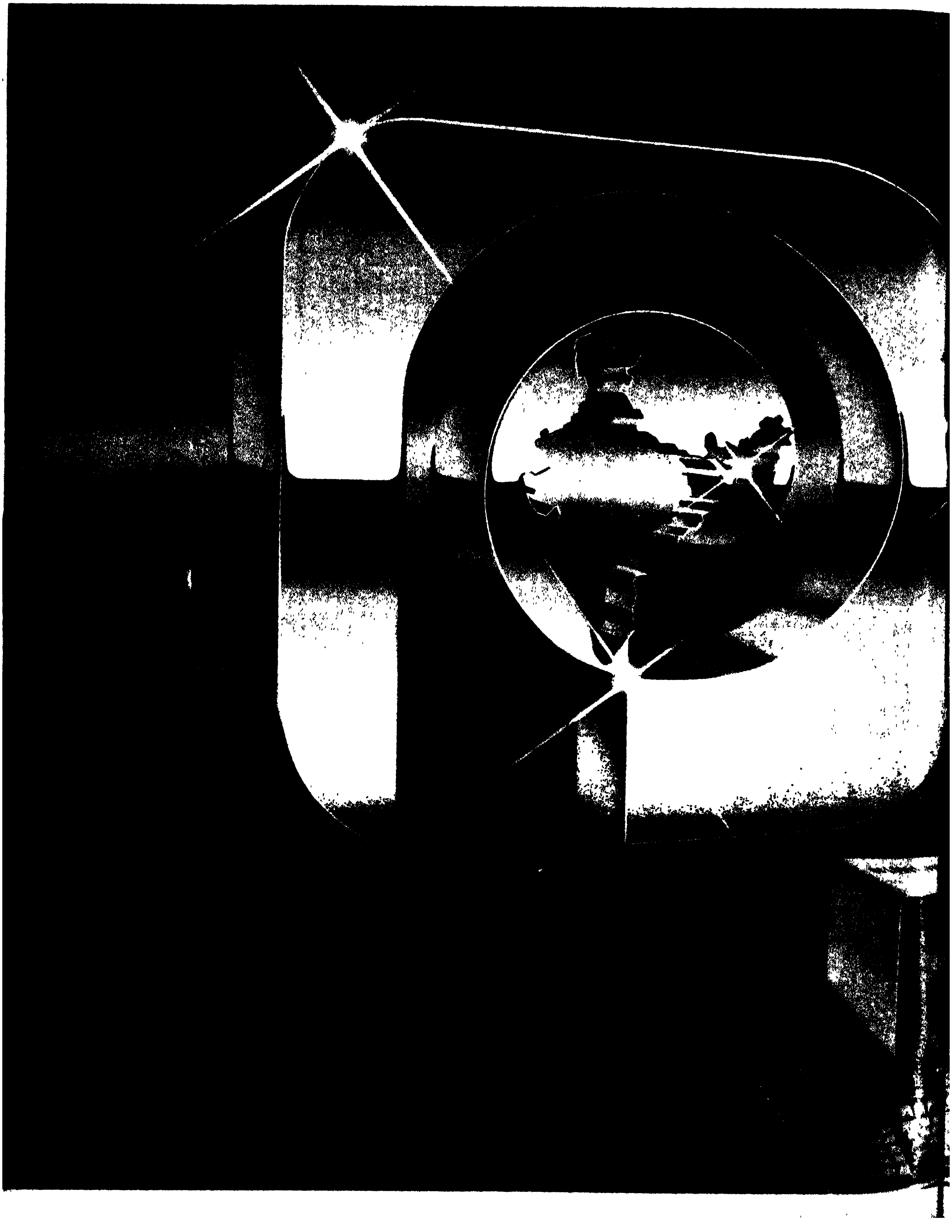

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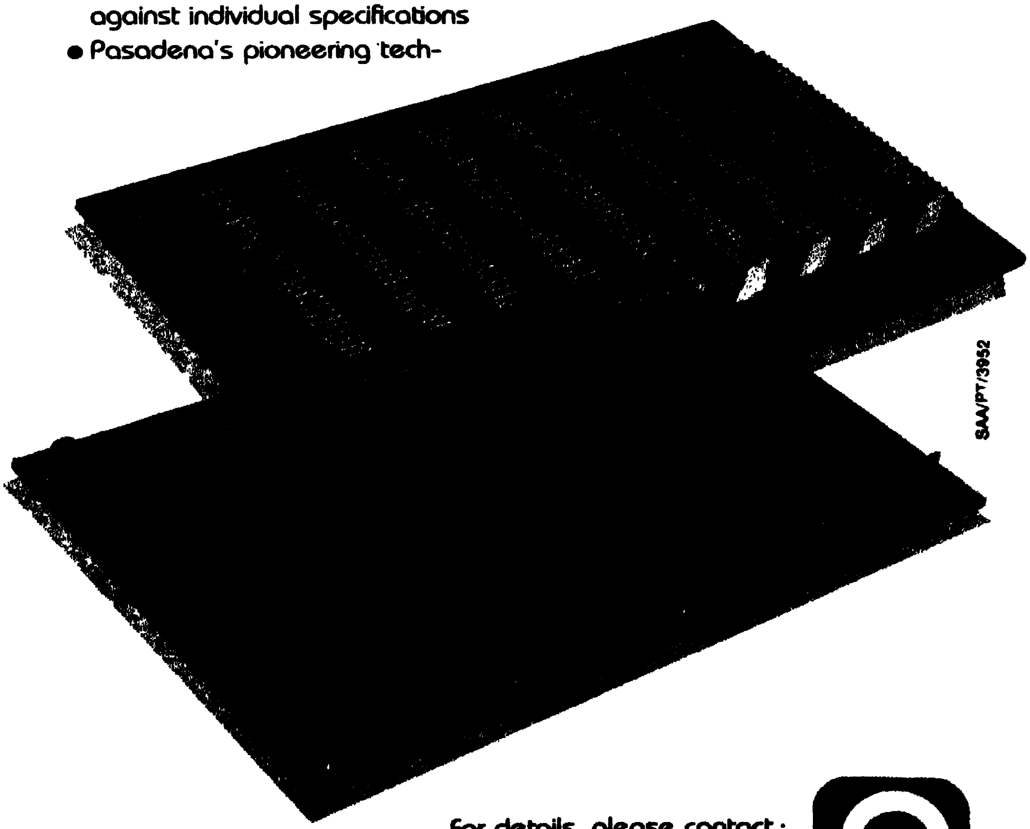

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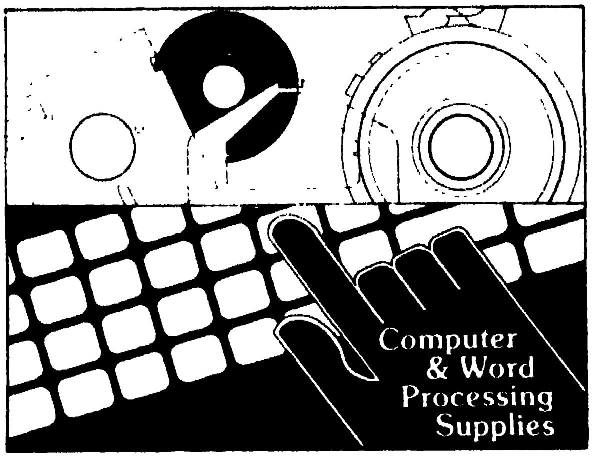

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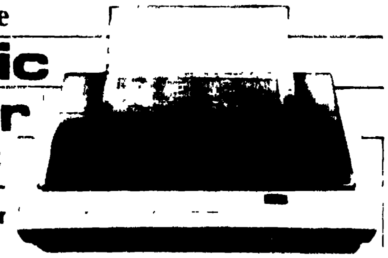

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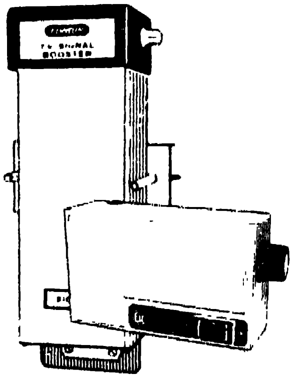

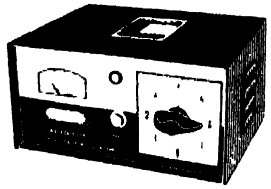

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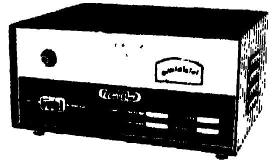

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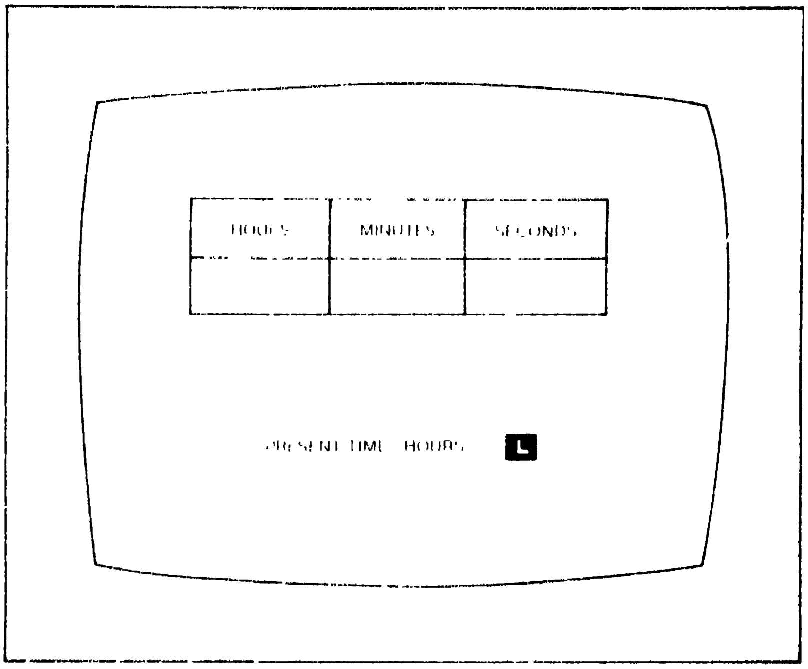
Stopwatch Cum Real-Time Clock Using Sinclair Spectrum



Ashok Baijal

Ever wondered how the computer clock is displayed on TV before the news broadcast? Well, why not try the program written for the Sinclair Spectrum and see it for yourself!

In Sinclair Spectrum, memory locations 23672 to 23674 contain a 3-byte frame counter which is incremented every 20ms. This facility has been used here for creating a stopwatch and real-time clock.

The memory location at 23672 counts from 0 to 255 and nudges the counter at location 23673 by 1 on receipt of the 256th pulse. Similarly, the counter at memory location 23674 is incremented after every 65536th (256×256) pulse. As you would be aware, the contents of any memory location can be seen by 'PEEK'ing into it. As such, the expression

(65536 * PEEK 23674 + 256 * PEEK 23673 + PEEK 23672) 50

gives the number of seconds since the computer was switched on.

Program lines 10 to 80 draw the clock's outlines on the screen.

Program line 90 holds the computer and waits for any key to be pressed to start the stopwatch.

Line 100 clears the memory locations 23672 to 23674 in the computer and sets the stopwatch to 0-0-0.

Line 120 defines the time function (T) and gives the time in 1/10th of a second.

Program lines 150 to 290 are the most important part of the program, as they print out the time every 1/10th of a second.

The stopwatch can be started by depressing any key on the keyboard (line 90), and can be stopped by pressing any one of the keys Q, Z or A. On stopping, the computer emits a beep sound (line 300).

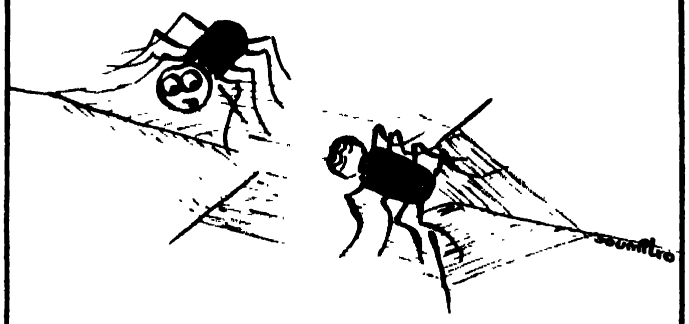
In order to have the real-time clock function, press key P (line 280). The computer then asks for the present time in hours, and then in minutes, so that the clock is set. On entering the minutes, the real-time clock starts and time is displayed on the screen. ☐

Program Listing

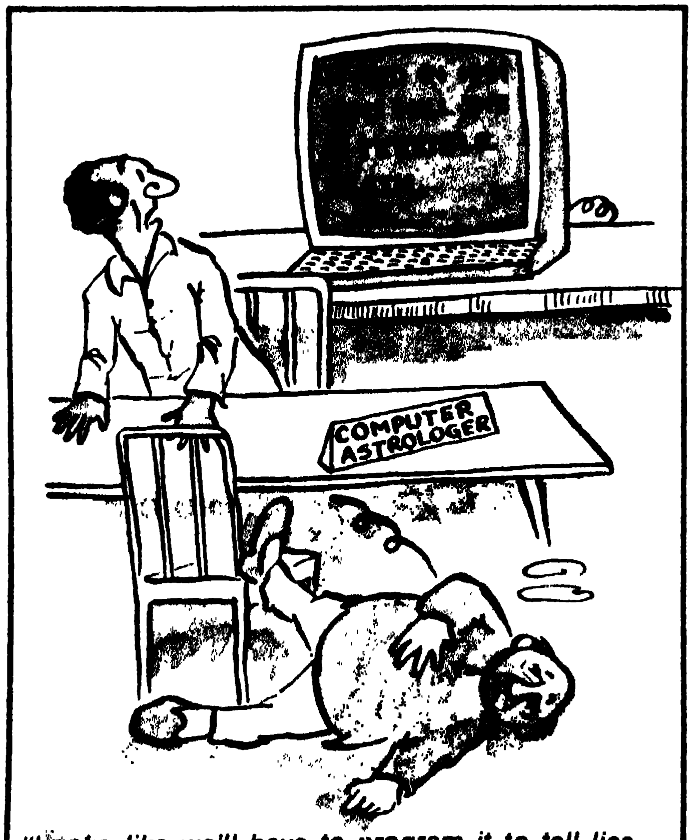
```
10   PRINT AT 7,6; "HOURS"; AT 7,14; "MINUTES"; AT 7,21; "SECONDS"
20   PLOT 36,92  : DRAW 194, 0
30   PLOT 36,100 : DRAW 194, 0
40   PLOT 36,124 : DRAW 194, 0
50   PLOT 36,124 : DRAW 0, -32
60   PLOT 98,124 : DRAW 0, -32
70   PLOT 164,124: DRAW 0, -32
80   PLOT 230,124: DRAW 0, -32
90   PAUSE 0
100  POKE 23674, 0 : POKE 23673, 0 : POKE 23672, 0
110  LET B = 0
120  DEF FN T() = INT ((65536 * PEEK 23674 + 256 * PEEK 23673
     + PEEK 23672)/5)
130  DEF FN M(X,Y) = (X+Y+ABS(X-Y))/2
140  DEF FN U() = FN M (FN T(), FN T())
150  LET A = B
160  IF INKEY$ = "Q" THEN GOTO 300
170  LET A = FN U()
180  IF A <= B THEN GOTO 170
190  LET W = INT A
200  IF INKEY$ = "Z" THEN GOTO 300
210  LET S = (W - 600 * INT (W/600))/10
220  LET E = INT (W/600)
230  LET M = E - 60 * INT(E/60)
240  LET H = INT (E/60)
250  IF H = 13 THEN LET J=1: LET K = 0 : GOTO 350
260  PRINT AT 9,8; H;"   "; AT 9,16; M;"   "; AT 9,23; S;"   "
270  IF INKEY$ = "A" THEN GOTO 300
280  IF INKEY$ = "P" THEN GOTO 330
290  GOTO 150
300  BEEP 4,4
310  PAUSE 0
320  GOTO 10
330  INPUT "PRESENT TIME - HOURS = "; J
340  INPUT "PRESENT TIME - MINUTES = "; K
350  LET L = 50 * (K*60+J*3600)
360  LET V = INT (L/256)
370  LET C = L-256 * V
380  LET N = V-256 * INT (V/256)
390  LET M = INT (V/256)
400  POKE 23674, M: POKE 23673, N: POKE 23672, C: GOTO 150
```

Electroons

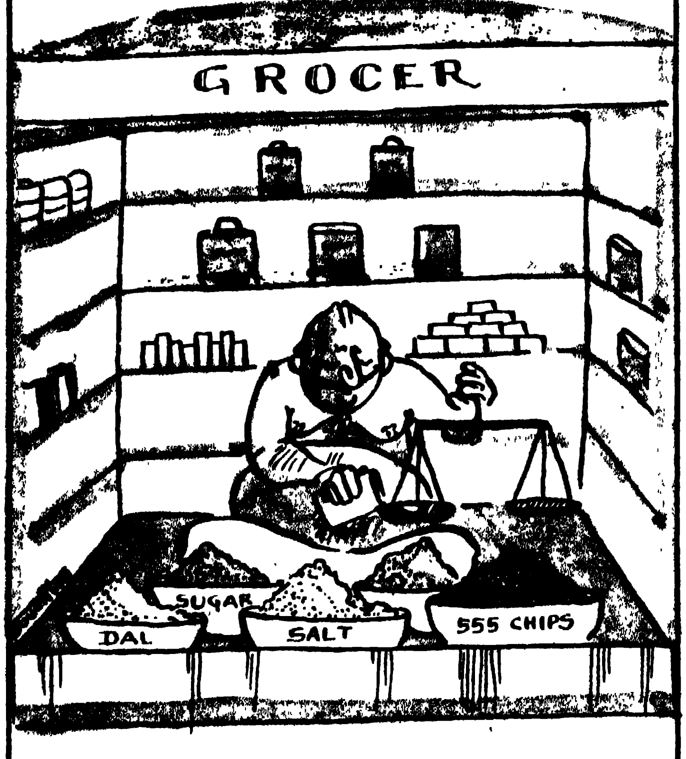
Soumitro Banerjee



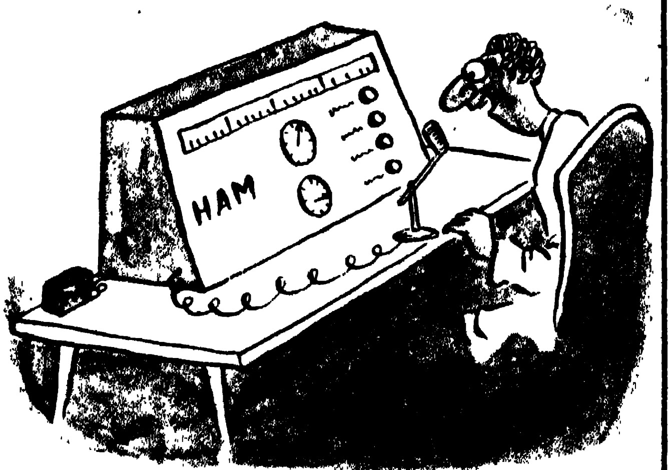
"Did you by any chance drop on the designer's desk? It seems a lot of our look alikes are coming out of the production line."



"Looks like we'll have to program it to tell lies sometimes."



The Trend



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Comparative Study of Computer Languages

Input Output Statements(3)

Part XII

R. Ramaswamy

The input statements give instructions to get the data into the program and the output statements give instructions to output the result on paper.

As in the case of FORTRAN and COBOL we have three methods for getting the data into the program in BASIC. They are:

1. Entering the data through the console.
2. Entering the data as a part of the program in the program itself.
3. Entering the data by asking the computer to read a data file kept separately.

We shall study the first two methods in this article and consider the third method later when we study about files.

Input statements in BASIC

The name of the statement which gives instructions to get the data through the console is called the INPUT statement. The general form of the INPUT statement is

```
INPUT list
```

The word INPUT is a code word which means that the computer is asked to get the data through the console. The list contains the variables separated by commas, whose values are entered or keyed through the console by the operator. Suppose one writes an INPUT statement as

```
INPUT A, B, C
```

On encountering the INPUT statement, the computer stops and puts a ? mark. Then the operator must key in the values of the variables one by one, separating each value by a comma. After entering three values corresponding to the three variables in the list, the computer proceeds to process the other statements in the program. Of course, the type and the number of variables in the list and the type and the number of values keyed through the console must match, otherwise an error condition will result.

When the computer simply puts a ? mark, the operator must know how many values he has to key. So we can give a prompt string to the operator to know how many values he has to key through the console by adding the prompt string within quote marks as shown below.

```
INPUT "ENTER THE VALUES OF A,B,C,", A, B, C
```

When the computer encounters the above INPUT statement, it simply prints the words within the quote marks without putting a question mark. Obviously this string is meaningful to the operator and so he starts keying the values of the variables A, B and C as displayed in the prompt string. The computer will proceed further only after getting the values of A, B and C.

Interactive mode or conversational mode

The above mode of entering data into the program through the console is called the interactive mode or the conversational mode. In this mode you can establish a dialogue between yourself and the computer. The computer will ask for the data by displaying the prompt string on the screen. You enter the data by keying on the console. If you enter wrongly, the computer gives a message on the screen as

"REENTER". The operator then re-enters the data. Thus the conversation can continue. Though this conversational mode is possible in other languages, it is found that BASIC is most suitable.

Statements for entering data in the program itself

The statement or the instruction to enter the data in the program itself is called the READ-DATA statement. The two key words READ and DATA go together, although they do not appear in the same statement or necessarily follow each other directly. However, for every variable listed after the word READ in a statement, there must follow a statement with the word DATA at some point in the program followed by the constants.

The computer matches the first READ variable with the first DATA constant, the second variable with the second DATA constant and so on. The DATA statement can be placed anywhere in the program as long as it precedes the END statement. The following example illustrates the READ-DATA statement.

```
READ A, B, C, D$
 ..

DATA 27.6, 789, 0, "KRIS"
```

The variables in the READ list and the constants in the DATA list are separated by commas. The data can be either in the integer mode or in the real mode, the only restriction being that the numeric data must correspond to the numeric variables and the string data must correspond to the string variables. We can also write the above READ-DATA statement as follows:

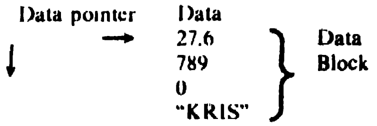
```
READ A, B, C, D$
 . .

 . .
DATA 27.6
DATA 789, 0
DATA "KRIS"
```

We observe that the number of DATA statements need not be equal to the number of READ statements, but the number of constants must be equal to the number of variables appearing in the READ list. If the number of variables exceeds the number of constants, the computer will give an 'out of data' error message. If the number of constants exceeds the number of variables, the surplus constants will be ignored.

Since READ statements generally precede the DATA statements, the usual practice is to place the READ statements at the beginning of the program and the DATA statements at the end before the END statement.

Visualising the data access in the READ-DATA statements

One can visualise the method of data access by the BASIC compiler in the READ-DATA statement. The BASIC compiler organises the contents of all the DATA statements in the program into a data block. During program execution one can visualise a pointer to move down the data block. When the computer reads the value of A, the pointer is directed to the data 27.6, somewhat as shown below. As soon as it reads the first data, the pointer moves down and positions itself against the next data and so on.



Sometimes it may be required to read the same set of data in another set of variables, say, E, F, G, H$. In that case the pointer can be restored to its original position by making use of a statement called the RESTORE statement.

RESTORE statement. The RESTORE statement transfers the pointer, regardless of where it is, to the first value of the data block. Suppose one writes

```
READ A, B, C, D$
DATA 27.6, 789, 0, "KRIS"
RESTORE
READ E, F, G, H$
```

As soon as the first READ statement is executed, the pointer comes down below the last data. At that time it is not pointing towards any data. As soon as the computer encounters the RESTORE statement, the pointer moves up and positions itself against the first data. So when the second READ statement is encountered, the same set of four values are read into the variables E, F, G, H$. If the RESTORE statement is not there, the computer will give an 'out of data' error message. Any number of RESTORE statements can be given. Everytime the computer encounters the RESTORE statement, the pointer is simply returned to the top of the data block.

The READ-DATA statement in BASIC is analogous to the DATA statement in FORTRAN and the VALUE clause statement described in the WORKING STORAGE SECTION in COBOL. In all these cases, the data is entered in the program itself. In BASIC, no formatting is required, i.e. the descriptions about the type of data, the length of data, etc are not required as in the case of FORTRAN or COBOL.

Output statements for printing the result on paper

The PRINT statement is used to output numerical or string data in the printed form. The general form of the PRINT statement is

```
PRINT list
```

The word PRINT is a code word to tell the computer to print the values. The list contains the list of variables whose values are to be printed. The variables are separated by commas. Suppose one writes

```
PRINT A, B, C, D
```

The values of A, B, C and D are printed in one line according to the built-in format.

Normally the printer length is 80 columns. This length is divided into four zones of 20 columns each. Each value is printed starting from the first column of each zone. If the values of A, B, C and D are 23.5, 45, 67.8 and 80 respectively, they will be printed somewhat as shown below:

```
1st zone     2nd zone     3rd zone     4th zone
  23.5          45          67.8          80
```

You may notice that the first column in each zone is blank. This space is for the sign. If the number is positive the first column will be left blank. If the number is negative the sign will be printed in the first column. If the list contains more than four variables, the items will be printed in the next line. So if the data items cannot be accommodated in one line, the printer will automatically go to the next line and print the data items zone-wise.

Suppose you want to print the data items closer, you can use semicolons as separators between successive variables. In the case of numbers one space will be left between two data items and in the case of strings no space will be left between the data items. Suppose one writes

```
PRINT A; B; C; D
```

Then the computer will print the values of A, B, C and D continuously, leaving one space between the successive values as follows:

```
23.5 45 67.8 80
```

Suppose the value of A$ is "SANKARA", the value of B$ is "SUBRA" and the value of C$ is "MANIAN", and if one writes

```
PRINT A$; B$, C$
```

the computer will print the result as

```
SANKARASUBRAMANIAN
```

The semicolons between string variables in the PRINT list will concatenate the string data items.

In case you want to print the result with some descriptive items, the descriptive items can be put within quotes and the PRINT statement written as follows:

```
PRINT "VOLUME OF THE CYLINDER IS", X
```

If the value of X is 4.58, the computer will print as

```
VOLUME OF THE CYLINDER IS 4.58
```

In the case of PRINT statements, which we have considered so far, the computer prints the result in a predefined format. It does not give the programmer sufficient facility to place the output data in the required locations. To overcome this difficulty, BASIC has another provision called the TAB function statement.

The TAB function

The general form of the TAB function is

```
TAB(X)
```

where X can be either a variable or an expression or a constant. Of course the variable, the expression and the constant must all be numeric. The expression X will be evaluated first and its integer value will be taken to position the printer before starting any printing operation. Suppose one writes

```
PRINT TAB(15); X
```

The TAB(15) function causes the value of X to be printed from the 15th column onwards. Once the TAB function is introduced, the permitted delimiter is the semicolon.

More than one TAB function can be used in the same PRINT statement to position more than one variable in the printer line. Suppose one writes

```
PRINT TAB(10); "RAJA"; TAB(14); "GOPALAN"
```

The above statement will generate the output from the 10th column onwards as

```
RAJAGOPALAN
```

Now, if one writes

```
PRINT TAB(10), "RAJA"; TAB(12); "GOPALAN"
```

We find that the value of the second TAB is less than the current print position and so the print value is shifted to the second line with the same TAB setting and the output will appear as

```
RAJA
  GOPALAN
```

It must be noted that everytime TAB function is executed in the same statement, the printer position is counted from the beginning of that line and not from the position it completed the printing of the previous value.

Print using statement

Sometimes it may be required to output only specified number of characters, either digits or strings in specified locations justified whether right or left. This can be done by representing the position of each digit or character by some special symbol called the image. For example, the image symbol for numeric digits is # (pronounced as hash).

Suppose you have a number 234.5679 stored in the location A and you want the computer to print the value rounded off to two digits to the right of the decimal point. One gives the specification as follows:

```
PRINT USING "####.##"; A
```

With the above specification, called the integer image specification, the value of A is printed only with two digits to the right of the decimal point, i.e., rounded off to two decimal places. The output will appear as

```
234.57
```

The remaining digits after the second decimal place are simply truncated. Suppose you have four values to be output with different number of digits with different spacings between them, the specifications can be written as

```
PRINT USING "####.## #### #####.# ##"; A, B, C, D
```

The hash symbol has got the necessary provision to suppress non-significant zeros.

Consider you have a number 00987.654 located in A, the specification for this will be given as

```
PRINT USING "######.##"; A
```

The computer will print the result as

```
987.65
```

You can notice that the two zeros in the non-significant positions have been suppressed. Again notice that the result in a numeric field is always right justified and this is what we require for the sake of alignment of the columns.

The USING statement can also be given as a separate assignment statement and used later in any number of PRINT statements. For example, one can write

```
FOR$ = "####.## ##### ##.## #######"
PRINT USING FOR$; A; B; C; D
```

Just as we write the format statement in FORTRAN separately, in BASIC also the format statement can be separately written as shown above. The same format statement can be used for any number of PRINT statements if required.

String image specification

We have said that the positions of numeric digits are symbolically represented by the hash sign. The hash sign is called the integer image specification. In a similar way a fixed length string data field of more than one position is specified by a pair of slashes (/) separated by zero or more characters. The width of the field is equal to the number of characters between the two slashes plus two. Any character can be placed between the slashes. These characters will be ignored by the computer and it will take them only as symbols for printing string data.

The string will be printed left justified in the given field width. If the string is longer than the field width, then it will be truncated on the right. If the field is longer than the string, then the string will be printed from the left end of the field, leaving blanks on the right end, i.e. we say that the strings are printed left justified in the given field. Suppose we give a print statement as follows:

```
FOR$ = "/ -- -       -                /"
PRINT USING FOR$, "R. KRISHNAN"
```

The FOR$ field is 22 characters long. The string data is only 11 characters long. The name R. KRISHNAN will be printed in the first 11 positions and the remaining 11 positions on the right will be left blank. We can use a single ampersand symbol (&) to represent strings of different length. Suppose one writes as follows:

```
FOR$ = "&"
PRINT USING FOR$; A$
```

In this case the length of the string stored by the variable A$ can be anything within the permitted length for a string constant. The full string will be printed without any truncation by the above FOR$ specification.

Print statement without any list

To give vertical spacing, the PRINT statement without any list is used. One dummy PRINT statement will skip to the next line. Suppose you want to print two items A and B in successive lines, one has to write as follows:

```
PRINT A
PRINT
PRINT B
```

But if you want to skip two lines, you have to give two dummy PRINT statements.

The purpose of the format statements is to tell the computer where and how the result should be printed on the paper. With some experience one can write many complex printing formats by combining different specifications depending on the need. In BASIC there is no format statement for reading data. Only for printing purposes formats are required in BASIC. If no formats are given the result will still be printed, but in that case the computer will use the built-in format for printing purposes. In FORTRAN formats are required both for reading and printing the data. In COBOL also formats are required both for reading and printing the data.

In BASIC formats can be either included in the print statement or given separately. In FORTRAN and COBOL formats have to be given by separate statements. In FORTRAN and BASIC the formats statements can be placed anywhere in the program. But in COBOL the format statements can be placed only in the DATA DIVISION of the program. The way of coding the formats in these languages are different.

Input statements in PL/1

We have three ways of entering data into a PL/1 program same as in the case of FORTRAN, COBOL and BASIC. These are:

1. Entering the data through the console.
2. Entering the data in the program itself.
3. Entering the data in the program by reading a file.

In this article we will consider the first two methods and study the third method later.

Input statements for entering the data through the console

The general form of the input instruction or the statement for entering the data through the console is

```
GET LIST(list)
```

The two words GET and LIST are key words which have special meaning to the computer. The word list inside the parentheses contains the list of variables whose values are to be entered through the console. The variables in the list are separated by commas. Suppose one writes

```
GET LIST (A, B, C)
```

The computer on encountering this statement will stop and wait until the operator keys in the data values for A, B and C. The variables can be either integers or reals or character strings or bit strings. This information must have already been given in the declaration statement in the beginning of the program. We have already said in the article on coding rules for variables, that every variable introduced in a PL/1 program must be declared as belonging to any one of the four categories. The declaration statement itself will be used as the format for reading the input data. There is no separate format statement required in PL/1.

The values that are keyed in must conform to the specifications of the variables declared earlier, otherwise an error message will be given by the computer. The GET LIST statement in PL/1 is analogous to the READ statement in FORTRAN, the INPUT statement in BASIC and the ACCEPT statement in COBOL. Though the above statements are intended for doing the same function of getting the data into the program through the console, the way of coding the instructions in the different languages are different.

Input statements for entering the data in the program

In PL/1, the data values for the different variables can be initialised in the declaration statement itself. The data values can be either numeric or string. Suppose you want to initialise the values of three variables A, B and C then you write down the declaration statement as

```
DCL (A, B, C) FLOAT BINARY STATIC INIT (12.5, 345, 79);
```

The word STATIC is a code word which tells the computer that the variables having this attribute can have their values initialised. INIT is another code word which simply means initial values. The actual values of the variables A, B, and C are enclosed within parentheses immediately after the code words STATIC INIT. The first part of the declaration is the same we have seen earlier.

Suppose one wants to give initial values for strings, e.g., to give values for two variables M1 and M2 as JANUARY and FEBRUARY respectively. Then the statement is

```
DCL (M1, M2) CHAR(10) VARYING STATIC INIT ('JANUARY',
'FEBRUARY');
```

The string values must be enclosed within quotes. The other key words have the same meaning which we have said earlier. The DCL-STATIC-INIT statement in PL/1 is analogous to the DATA statement in FORTRAN, the VALUE clause statement in COBOL, and the READ-DATA statement in BASIC.

Output statements to print the result on paper

Just as in BASIC, we have both formatted and unformatted print statements. The general form of the unformatted print statement in PL/1 is as follows:

```
PUT LIST (A, B, C, D);
```

A, B, C and D can be either numeric or string. Of course, they must have been declared in the beginning of the program, as it is mandatory to declare every variable that is used in a PL/1 program. If the variables are numeric, the values will be printed in the exponent notation with seven significant digits in the mantessa part. If the values of A, B, C and D are 1, 2, 3 and 4 respectively, then the computer will print the result as follows:

```
1.000000E+00 2.000000E+00 3.000000E+00 4.000000E+00
```

The computer divides the print line into zones, each zone having a width of 14 columns. The first value is printed in the first 14 columns, the second value is printed in the second 14 columns and so on. If there are more items, printing will be continued in the next line. The programmer has no control over the printing positions of the values. The computer is said to print the result according to a built-in format. Strings also will be output in a similar manner. Suppose you want to print the values of A and B in separate lines, you have to write as follows:

```
PUT SKIP LIST(A);
PUT LIST(B);
```

The key word SKIP will cause the movement of the print head to the next line after printing the value of A. The value of B will then be printed in the first zone of the next line. The PUT SKIP statement without any list will cause the movement of the print head to the next line without printing anything in that line. This statement is useful for giving vertical spacing between the output values.

Formats for output data items

Though no formats are required to read data items, it is necessary to have formats for presenting the output in a meaningful way. The format for each of the output data item is given in the output statement itself. The general form of the output statement with the format specifications for each data item is as follows:

```
PUT EDIT (list) (format list)
```

The code word EDIT tells the computer that the data items in the list must be printed as per the format list given at the end of the variable list. We will now introduce the format specifications.

A format. The general form is A(w), where A is a code word to tell the computer that the data item is a string and w represents the width of the string. If w is omitted, then w is assumed to be the length of the output string. If w is greater than the output string length, then blanks are added to the right. If w is less than the output string length, the string is truncated from the rightmost position.

F format. The general form is F(w,d), where F is a code word to tell the computer that the data item is numeric, w represents the width of the field or the number of digits in the field and d is the number of digits to the right of the decimal point. This format is used to output the data item in the floating point notation.

X format. This format is used to skip columns in a line. The general form is X(w), where X is a code word to tell the computer that it must move its print head by w columns in the same line.

Suppose you want to output four data items A, B, C and D whose values are 'KRIS', 23, 42.1 and 432.1 respectively. One can write the formats in the output statement as follows:

```
PUT EDIT (A, B, C, D) (A(4), X(2), F(3), X(2), F(4,1), X(2), F(5,1))
```

The printed output will appear as follows:

```
KRIS  23  42.1  432.1
```

Now if one wants to print the values of A and B in one line and the values of C and D in the third line, one writes the statement as follows:

```
PUT EDIT (A, B, C, D) (A(4), X(2), F(3), SKIP(2), F(4,1), X(2),
          F(5,1))
```

The word SKIP(2) causes the print head to skip two lines, counting being done from the current line. In general, SKIP(n) skips n lines and gives n-1 blank lines.

REMOTE format. The format specifications can also be given as a separate statement with a label put before it. Then this label is referred to in the format list. The advantage is that this labelled format can be used with a number of output statements. This type of formatting is referred to as REMOTE FORMAT in PL/1.

We give some label to the format list alone and write:

```
L1: FORMAT(A(4),X(2),F(3),X(2),F(4,1),X(2),F(5,1));
```

L1 is called the label or name of the format statement. The name followed by the colon mark enables the computer to identify it as the label of the statement. In FORTRAN we give numbers to statements for reference purposes. In PL/I we give names coined by alphabets or alphabets and numbers. A statement label is coined in the same way as we coin the name of a variable. To print the values of A, B, C and D as per the above format, we write

```
PUT EDIT (A, B, C, D) (R(F1));
```

The letter R is a code to indicate that the format is a REMOTE FORMAT and it is given in the statement which is labelled by the name enclosed within parentheses immediately following the letter R. The same format can be used by any number of output statements if required.

Formats can be given for printing reals in the scientific notation or the exponent notation. The general form is E(w,d), where w defines the field width and d gives the number of digits to the right of the decimal point. The output will appear as

```
+n.ddddddE+ee
```

So the format which one must give is E(13,6). The total width of the item is 13. One space is left for the sign, one for the decimal point, one for the integer part of the number, six for the fractional part of the number and four for the exponent coding part. The E(13,6) format can output the biggest as well as the smallest number that can be output by the PL/I program. The minimum value of w is d+7. If w is less than d+7, an error message will be given. If w is greater than d+7, the number will be printed right justified in the field leaving blanks on the left.

(To be continued)

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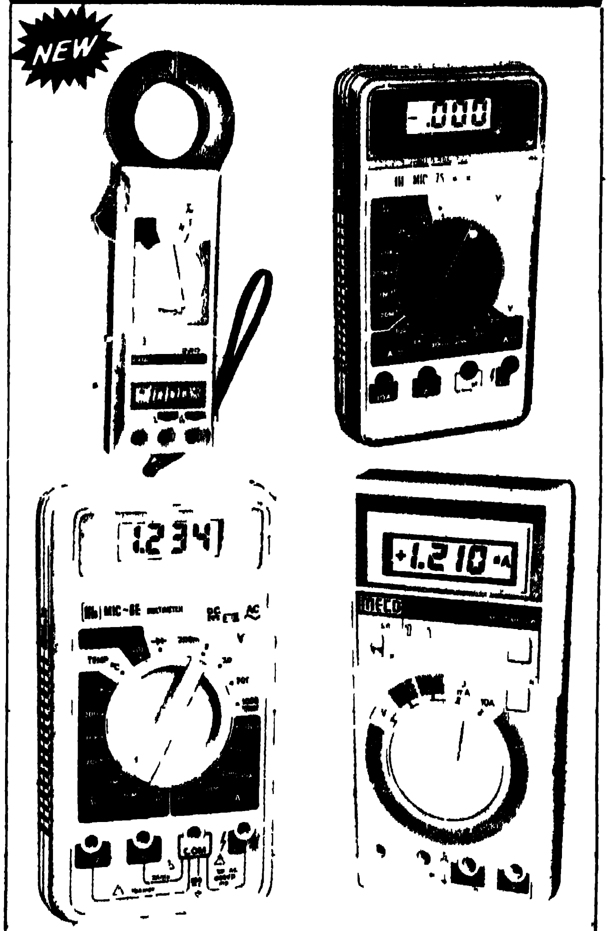

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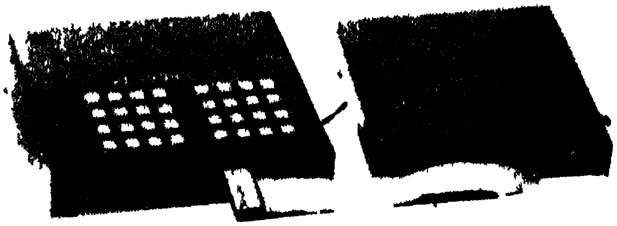

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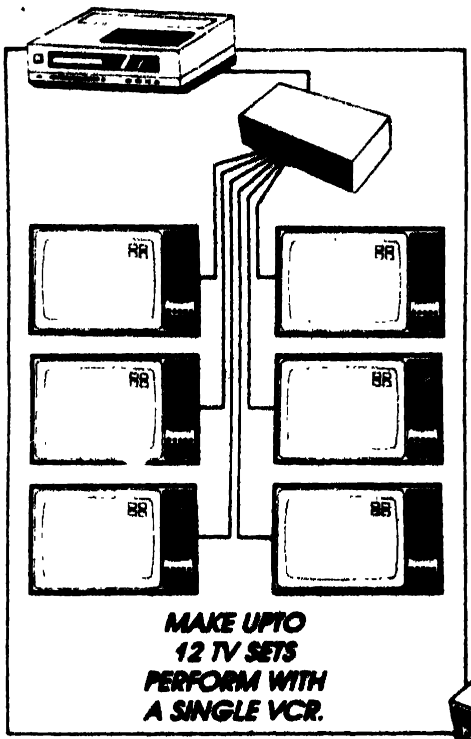

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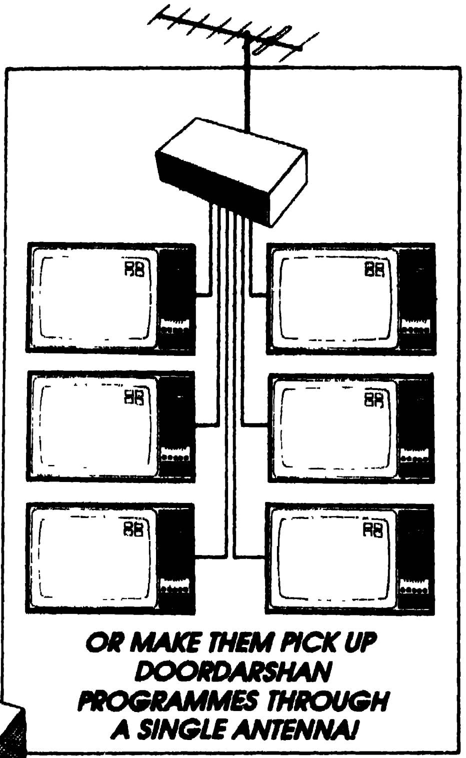

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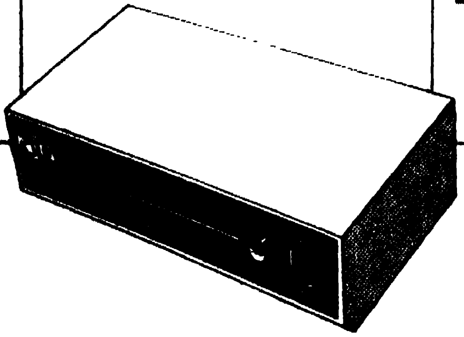

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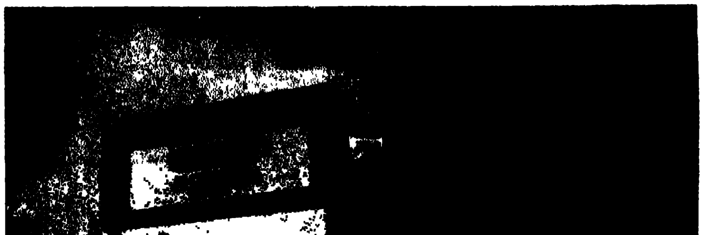
VHF TV Booster



Television boosters are generally used to improve the reception of signals in fringe areas where the strength of signals from far-off stations is weak. TV booster antennae are also used by TV DXers who wish to receive signals from distant TV stations, situated within the country or in a neighbouring country.

With the number of TV transmitters increasing rapidly, it becomes possible in some places to receive the off-air transmission programmes from more than one TV station. Sometimes, programmes from another country may also be received (e.g. Sri Lankan TV programmes in South India and Bangladesh TV in West Bengal). Many TV boosters are available in the market with a low gain and high noise. Commercially available TV boosters generally provide a voltage gain of about 30 dB which may not be sufficient for all purposes.

Why a TV booster?

TV transmission waves travel in straight lines and do not follow the curvature of earth. The strength of the signal

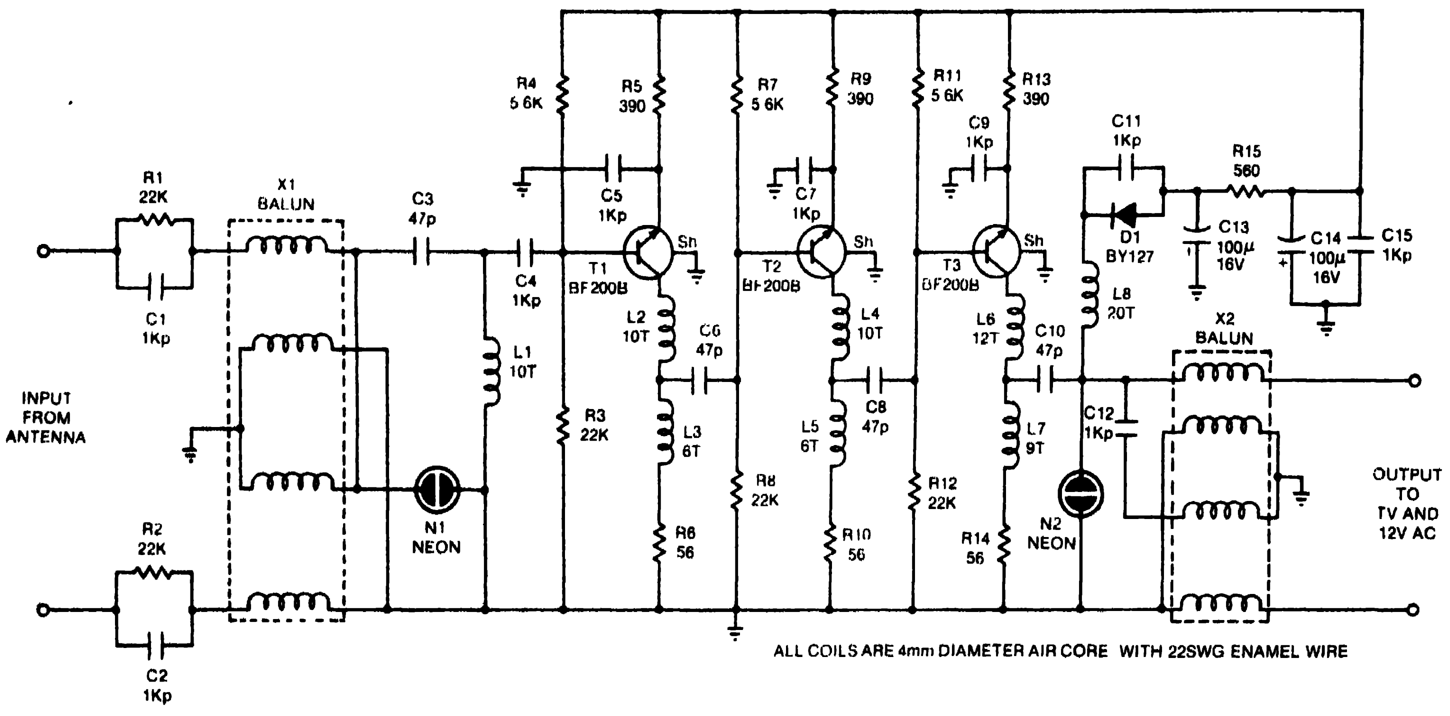


Fig. 1: Circuit diagram for the high-gain TV booster.

PARTS LIST

Semiconductors:

T1, T2, T3 — BF200B high frequency transistor
D1 — BY127 rectifier diode

***Resistors** [all ¼watt, ±5% carbon]:*

R1, R2, R3, R8, R12 — 22-kilohm
R4, R7, R11 — 5.6-kilohm
R5, R9, R13 — 390-ohm
R6, R10, R14 — 56-ohm
R15 — 560-ohm

Capacitors:

C1, C2, C4, C5, C7, C9, C11, C12, C15 — 1kpF ceramic disc
C3, C6, C8, C10 — 47 pF styroflex
C13, C14 — 100µF, 16V electrolytic

Miscellaneous:

L1-L8 — (see Fig. 1)
L9-L12 — RFC (radio frequency choke)
N1-N3 — 230V neon
S1 — SPDT switch
X1, X2 — Balun transformer
X3 — 12V, 300mA secondary transformer
— PCB, enclosure, mains cord, screws, spacers, hardwares etc.

decreases rapidly with increase in the distance between the transmitter and receiver. More so beyond the specified coverage area of the transmitter.

The 'line of sight' distance between the transmitting tower and the receiving antenna is determined by the following formula:

$$D = 4(\sqrt{a} + \sqrt{b})$$

where 'D' is the distance between the two antennae in kms, 'a' is the height of the transmitting antenna, and 'b' is the height of the receiving antenna.

The area lying within 10 to 15 kms from the transmitting antenna is called primary area. Within this region, the transmitted signal is quite strong and can be received without any TV signal amplifier (booster). Beyond the primary area, say, between 15 to 40 kms, is the secondary area. Receivers in this area do not require a booster, and a suitable high-gain antenna should do the job adequately.

But at distances around 80 kms, called the fringe area, a high-gain antenna with a high-gain booster mounted high above ground level is required. The signal strength in this area is very low and no satisfactory picture can be formed. The low signal strength here may be due to low signal capture by the antenna, improper sensitivity of the set used,

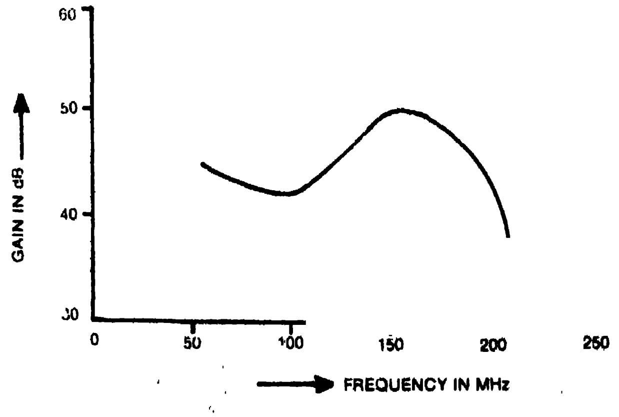


Fig. 2: Gain vs Frequency characteristics for TV booster.

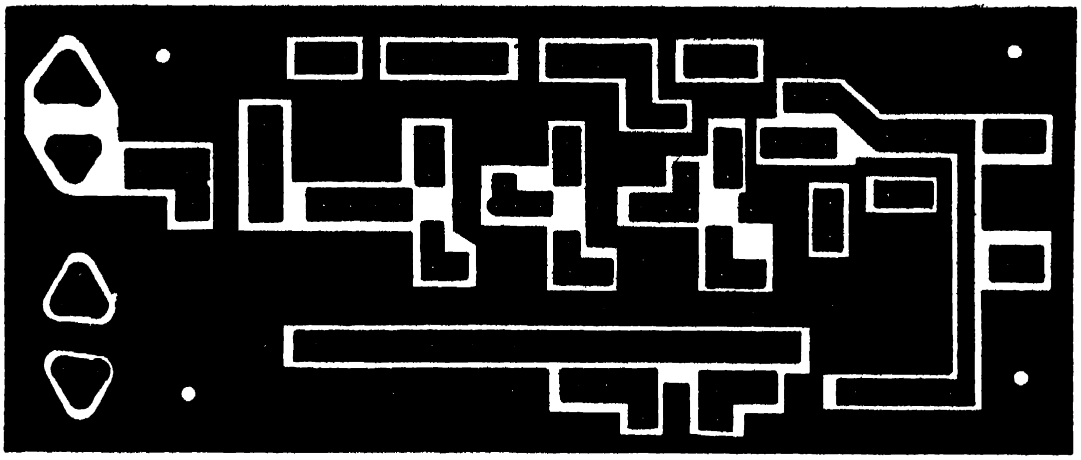


Fig. 3: Actual-size PCB layout for TV booster.

and high signal loss in the antenna connecting cable.

The feeder cable generally used between the receiving antenna and the TV set to complete the communication chain extends up to 15 to 25 metres. This is likely to lead to deterioration in reception as moisture and dirt reduce the ability of the cable to carry signals, and the signals received by the antenna are almost lost in transit in the cable.

Sometimes, noise due to RF interference from auto ignitions of vehicles, electrical sparking from nearby motor-operated equipment etc are picked up by the TV and these are found much stronger than the signal received. This may produce an unsynchronised picture (loss of vertical and horizontal synchronisation) with poor contrast and snow.

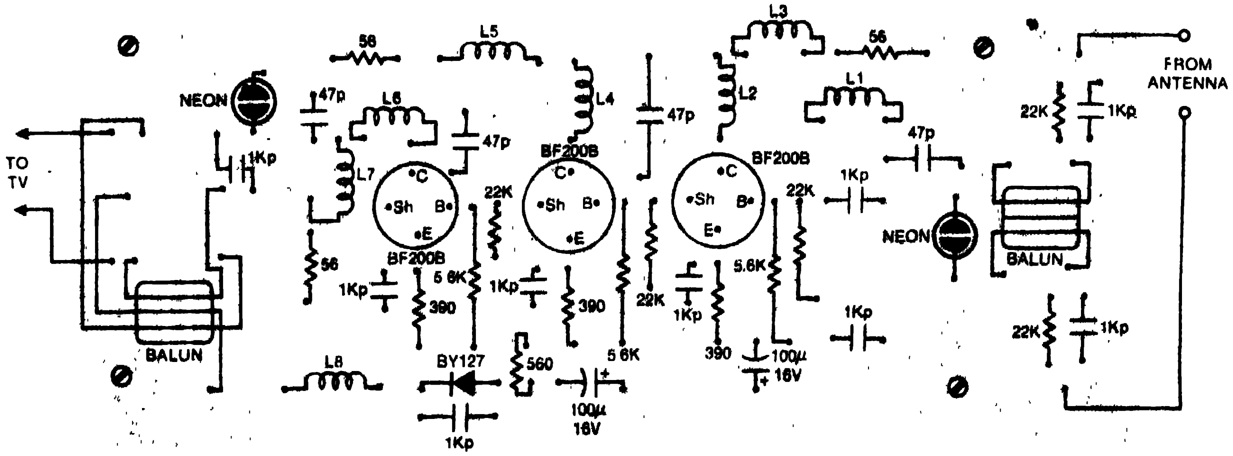


Fig. 4: Components layout for the PCB.

By including a TV booster, the TV signals are amplified several times compared with the interference signals picked up by the antenna or the cable.

Operation principle

The only solution to amplifying the weak TV signals is by the introduction of a number of preamplifiers having the same frequency bandwidth as that of the TV signals with a very little amount of noise figure. This set of RF preamplifiers should be connected in series with the signal line, i.e. the antenna cable. The number of preamplifiers cascading in series is limited to three or four since use of more preamplifiers creates a large signal-to-noise ratio and destroys the full amplification factor of the signal.

The transistors used as RF preamplifiers should be high-frequency, low-noise type. Otherwise they can create problems during amplification. A balun (BAlancing UNit) transformer is used to avoid impedance mismatching between the booster and the TV receiver.

One booster amplifier may be connected near the antenna, the source of the incoming signals to amplify the same, and another with the TV set for further amplification since some signal losses are likely to occur in the lead from the antenna. So we can say that the TV booster is generally a two-piece device—the outdoor unit housed in a weatherproof enclosure is fitted to the antenna mast, and the indoor unit is connected to the TV set.

Both the units contain a number of preamplifiers as mentioned earlier, tuned to the TV tower's transmitting frequency. A cable from the antenna (it may be coaxial type or a feeder wire) is connected to the preamplifiers (TV booster) to feed the received signal to their input. The amplified output signal from this booster runs down the mast to be fed to the TV set through another cable. The same cable also carries the low-voltage supply to the booster amplifier unit fitted to the antenna mast.

The indoor unit, also called the 'set-side' booster, contains a power supply circuit in addition to the set of preamplifiers. This low voltage AC supply is carried by the same lead from TV set to antenna mast so that there is no need for a separate wire. A splitter may also be used with the set-side unit for feeding the amplified signal if more than one TV receiver is used, but is not necessary otherwise.

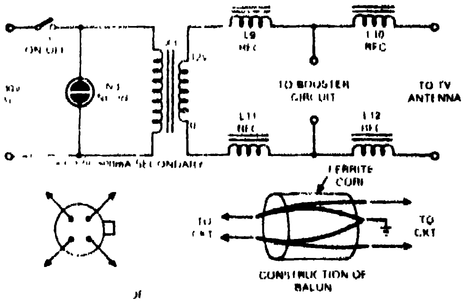


Fig. 5: Construction details of the balun transformer, BF200B transistor's pin diagram and the power supply circuit.

The circuit

BEL (Bharat Electronics Ltd) has recently developed a suitable circuit for high-gain TV booster amplifier for VHF operation using the newly developed BF200B transistor. The BF200B has higher gain than the existing BF200 devices. The transistion frequency of this device is more than 800 MHz and the noise figure is about 2.7 dB at frequency of 200 MHz. The circuit comprises three tuned preamplifier stages using BF200B, providing an overall gain of more than 40 dB in all the lower and upper VHF TV channels (i.e. ch. 2 to ch. 12).

Generally, circuits employing a number of inductors for broadband amplification tend to oscillate if proper care is not taken while providing the necessary shielding in printed circuit layout. Also, home constructors find difficulty in alignment. Keeping these points in mind, a three-stage RC coupled design (Fig. 1) is offered here along with a simple power supply. The unit offers a gain of 42 dB up to 100 MHz and about 50 dB up to 150 MHz (beyond 100 MHz) as shown in the gain vs frequency characteristics curve (Fig. 2). It is most suitable for fringe areas and deep fringe TV viewers.

TV signals picked up by the antenna are fed to the base of T1 via C1 to C4 through balun transformer X1 and the trap circuit comprising L1, L2 and L3. The balun transformer converts 300-ohm balanced antenna input to 75-ohm unbalanced output. The partly amplified signal from T1 is fed to the inputs of T2 and T3 for further amplification. Finally, the amplified output appearing at the collector of T3 is coupled to the other impedance-matching transformer (X2) by C10. X2 converts the 75-ohm unbalanced output to 300-ohm balanced output. A feeder cable may be connected to X2 to carry the signal down to power supply as well as to the set-side booster unit.

Construction

Transistorised preamplifiers carrying very high frequencies are used in the circuit. So a printed circuit board layout with proper shielding is required. A suitable PCB layout and the component layout are given in Figs 3 and 4 respectively. This makes the assembly job easier for an average home constructor. The whole booster assembly should be housed in a metal enclosure.

At the time of PCB wiring be careful about the pin configuration of the transistors. And after completing the soldering job, clean the greasy area on the copper track of PCB with the help of petrol and an old toothbrush.

Note: Generally only one TV booster is used in the antenna mast but here use of two boosters is suggested for better results but one can also be used (i.e. in antenna mast). □

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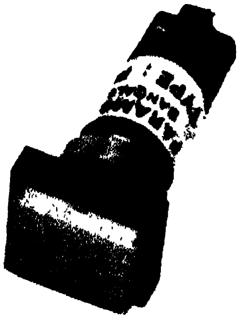

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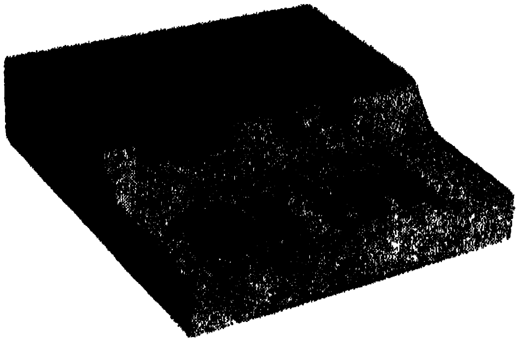

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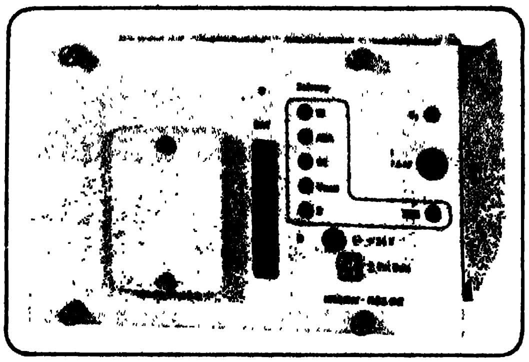
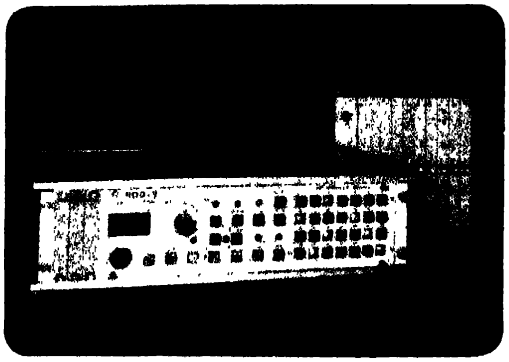
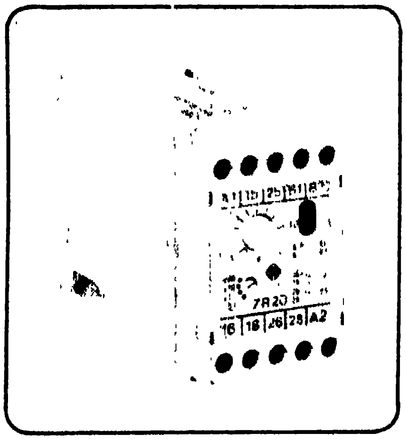


Ursalog 5021 TRS 10. This industrial robot control system is ideal for spray painting. When used with Basic Cinematic Unit IFA TR10, it can control Cinematic Systems that have up to eight degrees of freedom (axes), potentiometric measuring systems and a hydraulic drive.



ROG-8. This program control cassette can be used in control mechanisms for handling, joining and transporting goods. Only the selected sequence needs to be programmed as the control structure is pre-programmed by the manufacturer as per specification



ZA20 and ZR20. These electronic relays with four changeover time-lag ranges and continuous setting within the ranges permit versatile applications in industrial control equipment. ZA20 (delayed pick-up) relays are started by cutting in the working voltage and enable remote setting. ZR20 (delayed drop-out) relays are started by a normally closed contact that is free from potential while the working voltage is being supplied. Two LEDs indicate the cut-in condition of the working voltage, the running down of time, and the switching condition of the output relay.

Ursadat 5000. Modules of this microprocessor based system enable such applications as articulated robot control, flame cutting machine control and anti-friction grinding machine control. A multitude of interfaces permits coupling with data input and output devices, such as printers, punchers, floppy discs and magnetic tape drives, and also with other automation equipment.

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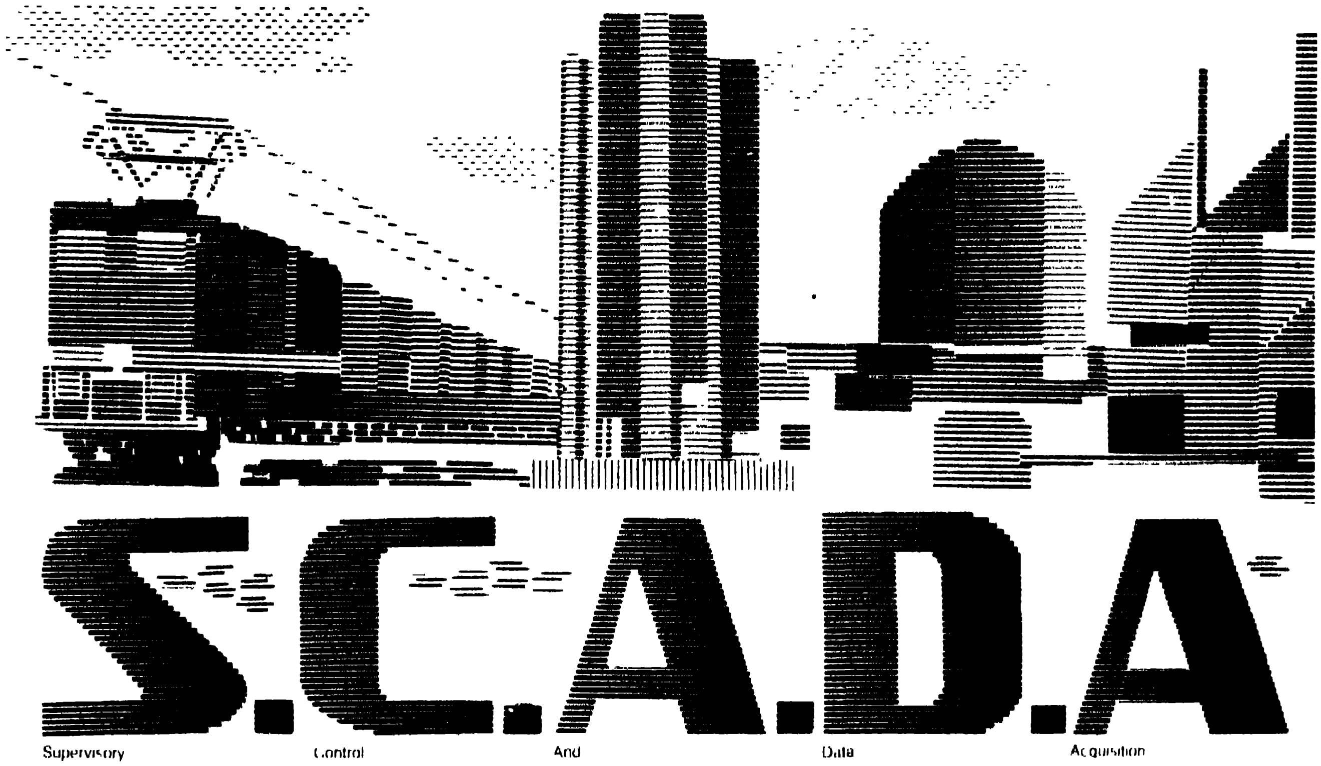

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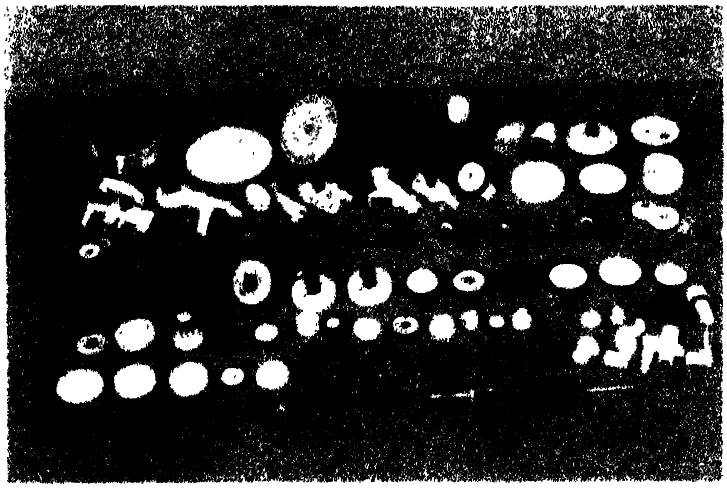

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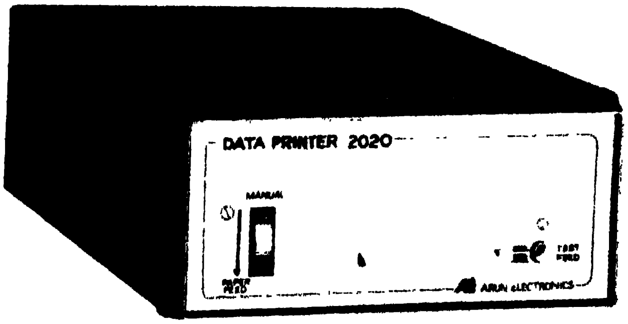

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Construction

S. Das Gupta

Stereo Control Cum Preamplifier For 120W+120W Amplifier

As promised last month, here is a preamplifier project to go with the 120W+120W amplifier project published in May issue. This preamplifier can in fact be used equally well with almost any other audio amplifier, including the 25W+25W amplifier project published in June 1984 issue of this magazine.

The quality of sound we get from a stereo system or an audio amplifier depends very much on the quality of preamplifier and tone control systems incorporated in their amplifier stages.

The most common sources of programmes for a general listener are the tape deck, radio tuner or a record player with magnetic or crystal (ceramic) pick-up. Sometimes microphones are used with a high power system for public address applications.

Tape decks are now becoming quite popular due to availability of low-cost stereo prerecorded cassettes. These decks are designed to feed low-level audio signals to a high quality

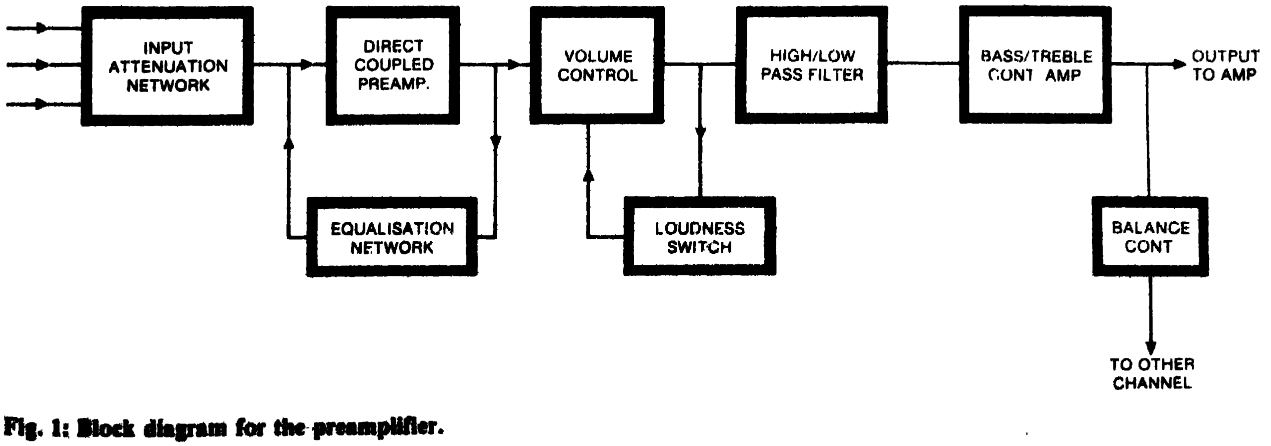


Fig. 1: Block diagram for the preamplifier.

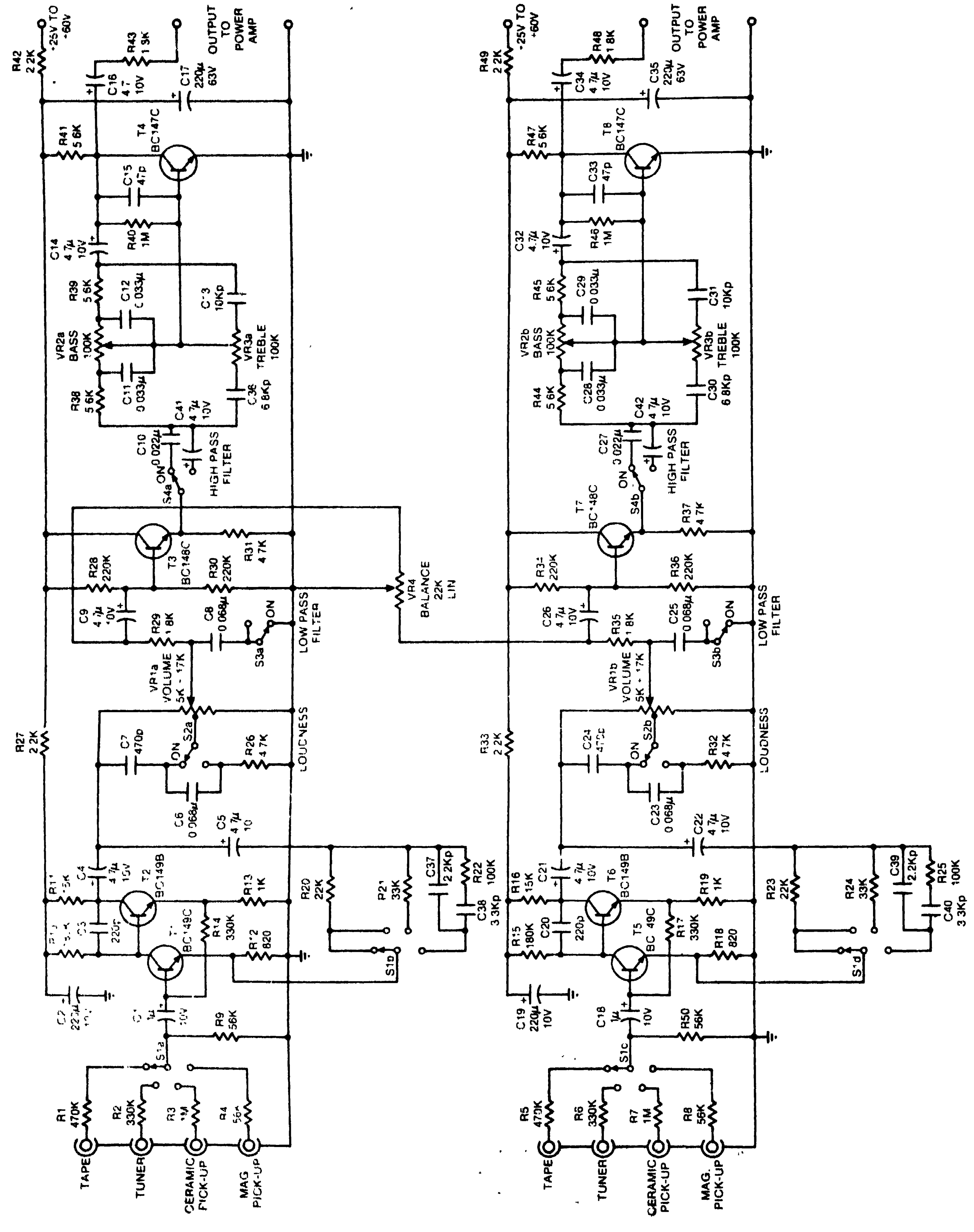


Fig. 2: Circuit diagram for the preamplifier, both channels are shown.

PARTS LIST

Semiconductors:

T1, T5 — BC149C low-noise npn transistor
T2, T6 — BC149B low-noise npn transistor
T3, T7 — BC148C npn AF transistor
T4, T8 — BC147C high-gain npn transistor

Resistors [all 1/4-watt, ±5% carbon]:

R1, R5 — 470-kilohm
R2, R6, R14, R17 — 330-kilohm
R3, R7, R40, R46 — 1-megohm
R4, R8, R9, R50 — 56-kilohm
R10, R15 — 180-kilohm
R11, R16 — 15-kilohm
R12, R18 — 820-ohm
R13, R19 — 1-kilohm
R20, R23 — 22 kilohm
R21, R24 — 33-kilohm
R22, R25 — 100-kilohm
R26, R31, R32, R37 — 4.7-kilohm
R27, R33, R42, R49 — 2.2-kilohm
R28, R30, R34, R36 — 220-kilohm
R38, R39, R41, R44, R45, R47 — 5.6-kilohm
R29, R35, R43, R48 — 1.8-kilohm
VR1 — 5k+17k log dual potentiometer
VR2, VR3 — 100k lin. dual potentiometer
VR4 — 22k lin. potentiometer

Capacitors:

C1, C18 — 1µF, 10V electrolytic
C2, C19 — 220µF, 10V electrolytic
C3, C20 — 220pF styroflex
C4, C5, C9, C14, C16, C21, C22, C26, C32, C34, C41, C42 — 4.7µF, 10V electrolytic
C7, C24 — 470pF ceramic disc
C6, C8, C23, C25 — 0.068µF polyester
C10, C27 — 0.022µF polyester
C11, C12, C28, C29 — 0.033µF polyester
C13, C31 — 10kpF polyester
C15, C33 — 47pF ceramic disc
C17, C35 — 220µF, 63V electrolytic
C30, C36 — 6.8kpF styroflex
C37, C39 — 2.2kpF ceramic disc
C38, C40 — 3.3kpF ceramic disc

Miscellaneous:

S1 — 4-pole, 4-way switch
S2, S3, S4 — DPDT switch
— RCA sockets, PCB, shielded wire, enclosure, knobs, lugs and fittings etc.

---

preamplifier or control amplifier to boost and process the basic signal for further amplification. Tape deck and radio tuner outputs vary from 200 mV to 500 mV p-p (peak-to-peak).

Disc players available in India have either crystal pick-ups or magnetic pick-ups. Crystal pick-up record players can be connected directly to a preamplifier without 'equalising'. But they require a very high impedance (about 1-megohm) preamplifiers. Otherwise there is considerable loss of low frequency components (bass).

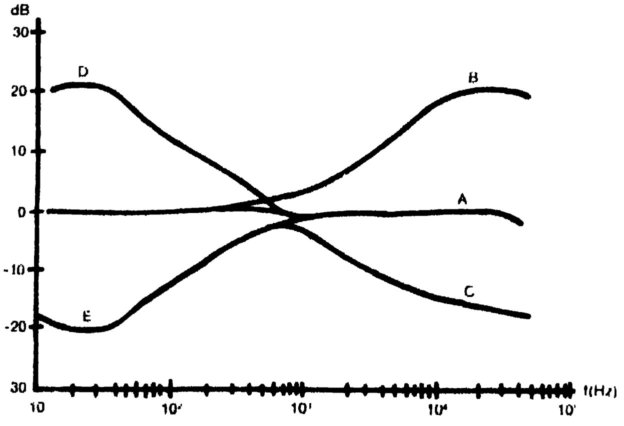
Crystal pick-ups generally produce 1V p-p output signal. But the preamplifier in this case is required to accept a signal level of about 300 mV with an input impedance of 1-megohm. Besides, an extra precaution has to be taken to prevent damage of input transistor if and when the pick-up cartridge slips while playing a record which generates a voltage of the order of 100V p-p.

Magnetic pick-ups are however more suitable for a true high fidelity than a crystal pick-up, give a much lower output signal (approx. 3 mV), require a high gain and well equalised preamplifier for a proper amplification of the low signal voltage. This leads to some complications in the designing of the preamplifier, and precautions have to be taken to prevent feedback and instability in frequency response.

The circuit

A suitable multipurpose preamplifier cum control amplifier is therefore offered here. It is designed specifically for operation with the 120-watt power amplifier circuit published in May 1986 issue of EFY as well as with the 25-watt power amplifier project published in July 1984 issue. It is nonetheless suitable for use with almost any power amplifier as it is capable of delivering 500 mV to 1V p-p at 1-kilohm output impedance.

The circuit has provision for almost all types of input sources, viz, tape deck, radio tuner, crystal pick-up and



CURVE A - BASS AND TREBLE CONTROL IN MID POSITION
CURVE B - MAXIMUM TREBLE, BASS FLAT
CURVE C - MINIMUM TREBLE, BASS FLAT
CURVE D - MAXIMUM BASS, TREBLE FLAT
CURVE E - MINIMUM BASS, TREBLE FLAT

Fig. 3: Frequency response characteristics of the tone control circuit.

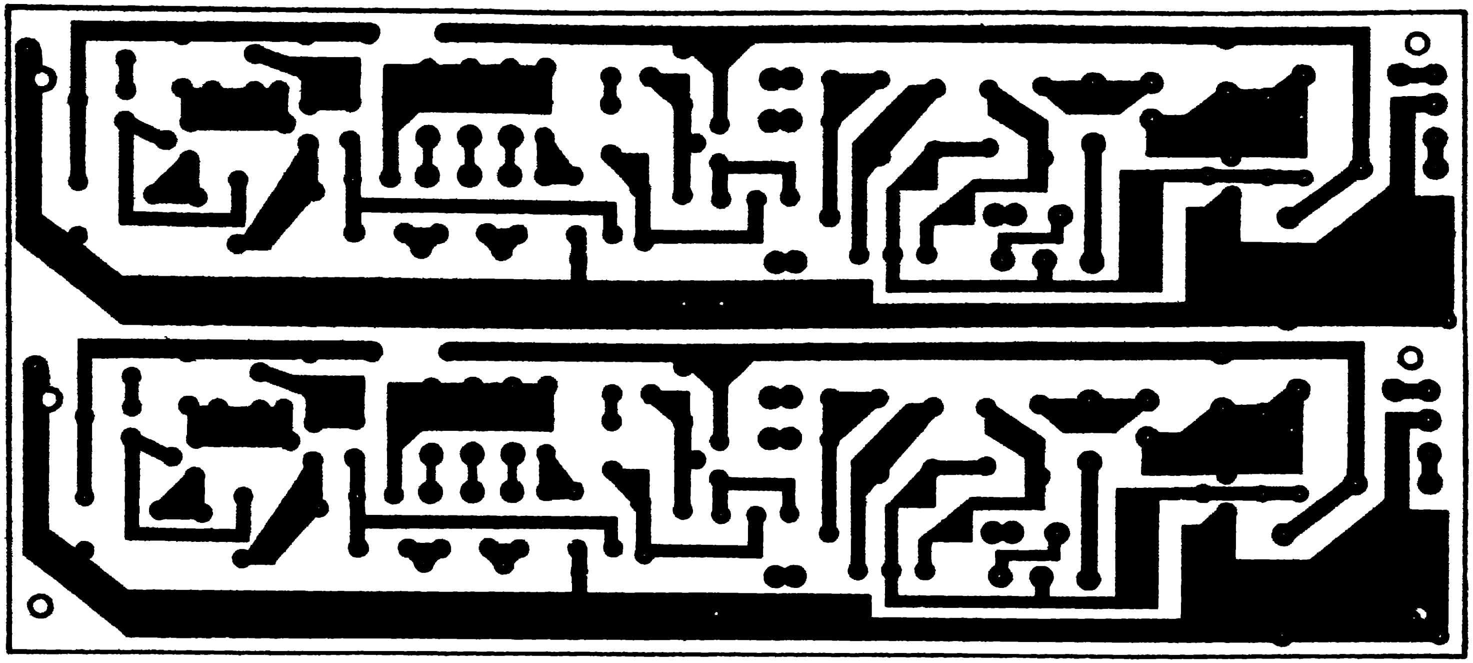


Fig. 4: Actual-size PCB pattern for both the channels of the preamplifier circuit.

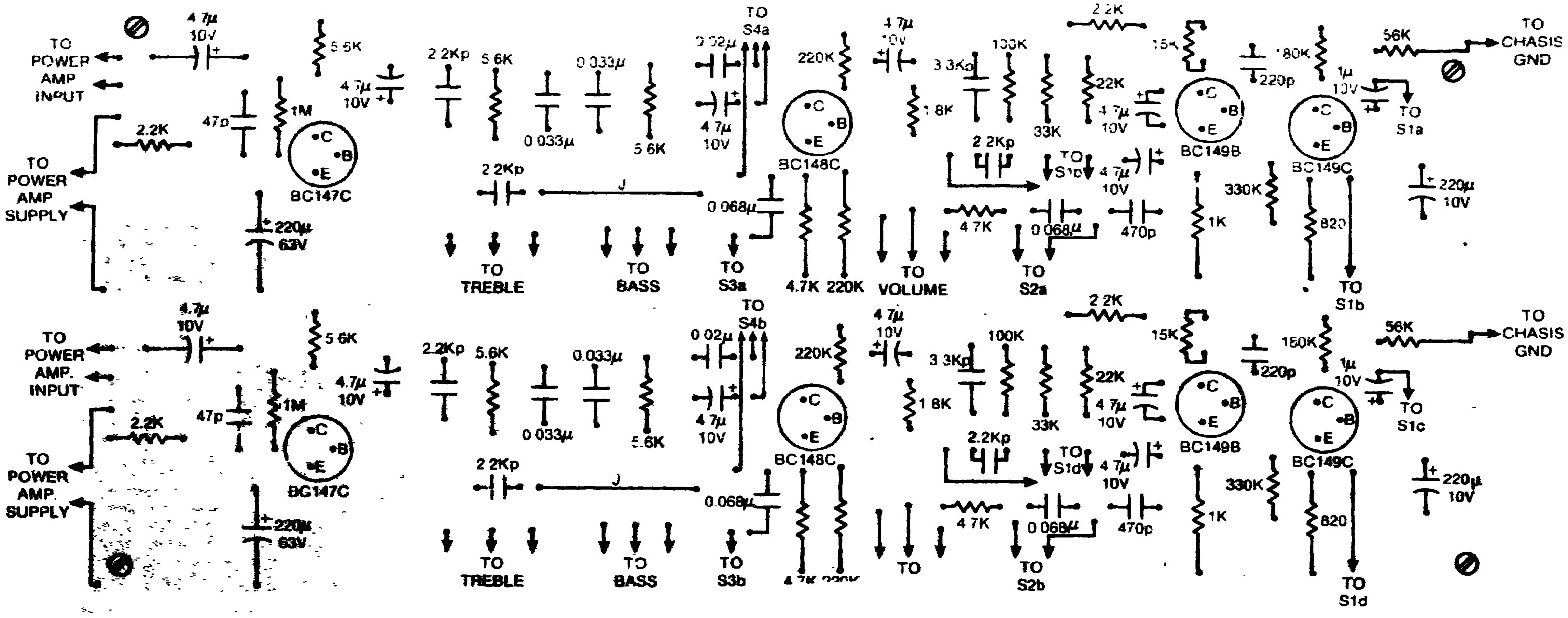


Fig. 5: Components layout for the PCB.

magnetic pick-up. The magnetic pick-up equalising characteristics of the preamplifier are in accordance with the RIAA (Recording Industry Association of America) standard. In addition, the circuit provides 'tape out' signal of about 300 mV for tape recording. It also provides for loudness control and 'hi-pass' and 'lo-pass' filters.

The preamplifier is designed such that it employs a very high AC and DC feedback which leads to a very low distortion level of less than 0.2 per cent with the prescribed values of components.

Table I shows the frequency response, input sensitivity and input impedance of the preamplifier with different input sources. The rated figures were measured with a 15MHz oscilloscope by feeding sinewave signals.

TABLE I

Input Source	Input Impedance (approx.)	Input Sensitivity (approx.)	Frequency Response
Tape deck	470-kilohm	300 mV	20Hz-30kHz
Radio tuner	470-kilohm	200 mV	20Hz-25kHz
Magnetic pick-up	47-kilohm	5 mV	20Hz-20kHz
Crystal pick-up	1-megohm	500 mV	20Hz-30kHz

Working principle

The block diagram of the preamplifier is shown in Fig. 1 and its circuit diagram is shown in Fig. 2. Eight low-noise npn transistors have been used for broadband amplification and a low distortion figure.

The first two transistors are direct coupled to ensure a good frequency response. The first and second stages use BC149C and BC149B silicon transistors for high gain with a low signal-to-noise ratio. Base bias to transistor T1 (and T5) is obtained through a 330k resistor connected between T1's base and emitter of the next transistor T2 (T5's base and T6's emitter in case of T5). This system of giving base-bias ensures bias stabilisation and is called DC feedback.

AC feedback is provided in the form of an equalising network. It depends totally on the type of input source and determines the gain of the preamplifier. In case of a magnetic pick-up, the feedback circuit comprising R22 (100k), C38 (3.3 kpF) and C37 (2.2kpF) provides the equalisation in accordance with the RIAA characteristics required for magnetic pick-up. It should be remembered that all other inputs are frequency independent and have a flat response.

Emitter-follower stage comprising transistor T3 (and T7) is employed to obtain a high input impedance and low output impedance to make the operation of the tone control circuit totally independent of the volume control settings. The tone control circuit itself, which is the heart of the sound shaping circuit, is the well-known Baxandall type circuit. It is used here to avoid all the common defects of high distortion under signal boost conditions.

Bass and treble potentiometers are connected in the feedback loop between the base and collector of output transistor T4 (and T8). The main advantage of this feedback system is that a low output impedance is maintained while both the controls can be varied independently. The rates of boost and cut of the bass and treble controls are ±25 dB at 20 Hz and ±20 dB at 20 kHz respectively (see curve 'b', 'c', 'd' and 'e' in Fig. 3.). When both the controls are in their mid positions, then the frequency response curves are flat (see curve 'a' in Fig. 3) and the feedback is practically independent of frequency.

Construction

A suitable printed circuit board layout is given in Fig. 4 for stereo application. The component layout (Fig. 5) shows the placement of all the components for a stereo system as well as the external connections that have to be made for volume, bass and treble controls, and for filter switches.

All the controls, filter switches and the selector switch are mounted on the front panel of the enclosure. Input and speaker sockets are normally fitted on the rear panel.

Remember that the printed circuit board should be mounted close to the controls and switches in order to keep the interconnections as short as possible for avoiding hum and distortion. Three-core shielded wire should be used for all internal wirings. □

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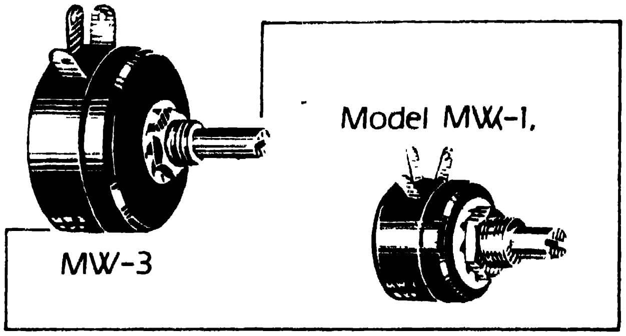

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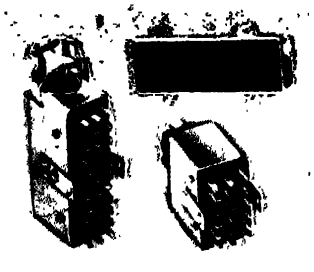

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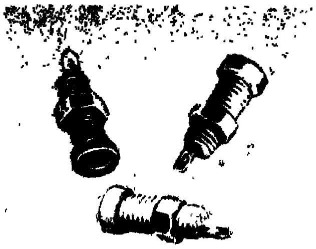

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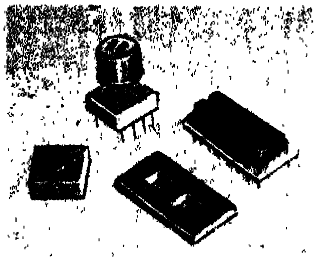

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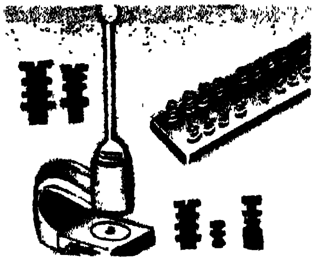

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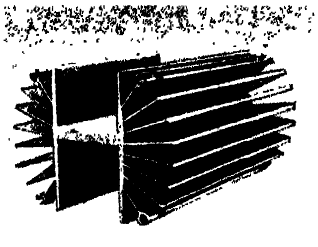

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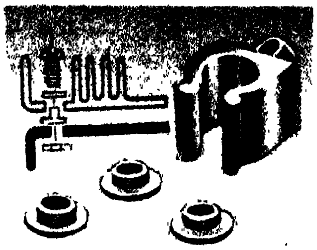

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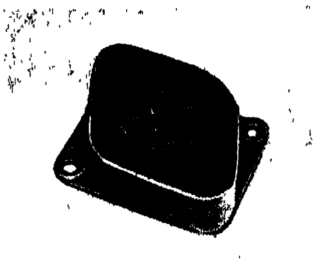
- PCB from cabinet
- Hold LEDs Transistors diodes & cables to the PCB



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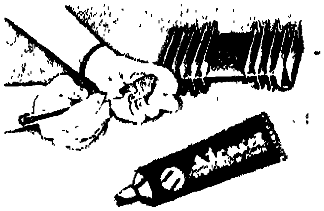

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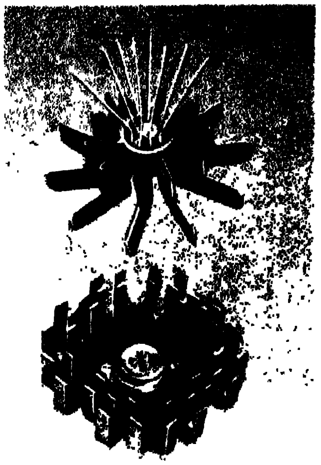

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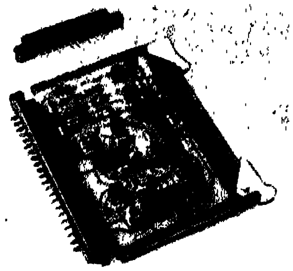

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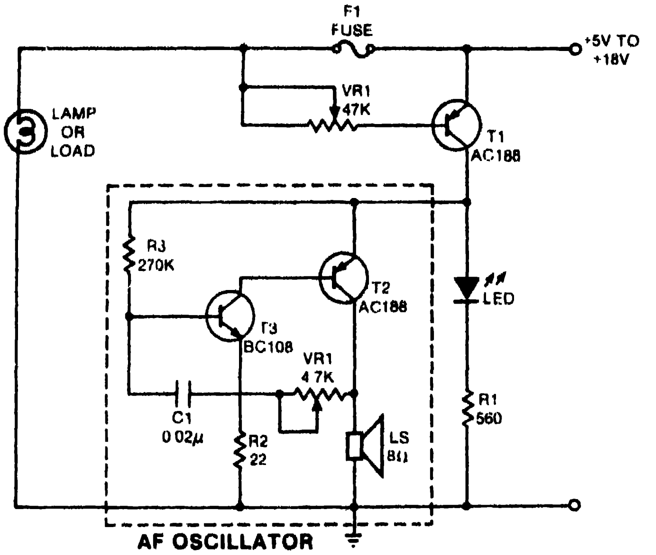
Blown-Fuse Indicator

Transistor T1 here senses the voltage across the fuse under guard and operates a visual indicator along with an aural indicator when the fuse opens or the voltage across the fuse equals the minimum forward bias.

Initially, the base of T1 is kept at reverse bias. When the fuse blows, T1 gets forward biased through VR1 and load, and starts conducting. The oscillator and LED are now connected to positive rail and operated. Also, even if resistance of the fuse goes up due to overheating etc, the transistor activates the indicator well before the actual opening of fuse occurs.



It can be seen that the LED itself is enough to indicate the blown fuse. But if T1 is a high-leaker, the LED may flicker (although dimly) and confuse. So the indication can be specific if the beeper also joins in.

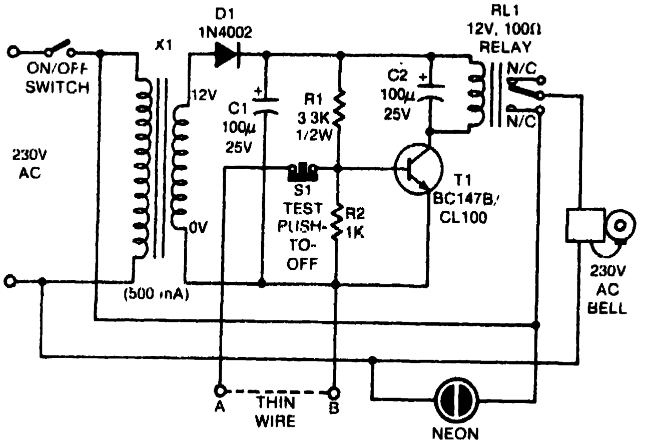
At higher load currents, even a good fuse may develop enough bias for T1 and raise a false alarm. For this, VR1 is inserted to make up the error in the bias.

M.K. CHANDRAMOULEESWARAN

Burglar Alarm

Here is a simple circuit of a conventional burglar alarm which uses just a few 'off-the-shelf' components, the total cost of the circuit (except for the alarm) being about Rs 40 only.

Step-down transformer X1 along with diode D1 and capacitor C1 forms the power supply circuit. Base bias for transistor T1 is provided by the potential divider formed by R1 and R2. However, when points A and B are shorted by a thin wire (a 44SWG copper wire will serve the purpose), the base of T1 is grounded and the transistor does not conduct.



When the wire is snapped by an intruder, T1 conducts energising relay RL1, and the alarm starts. The alarm can be any 230-volt operated device such as a buzzer, a bell or even a cassette player recorded and preset at full volume so that a loud voice saying "CHOR CHOR" is heard.

The neon indicates that the unit is 'on' and S1 serves to test the functioning of the alarm.

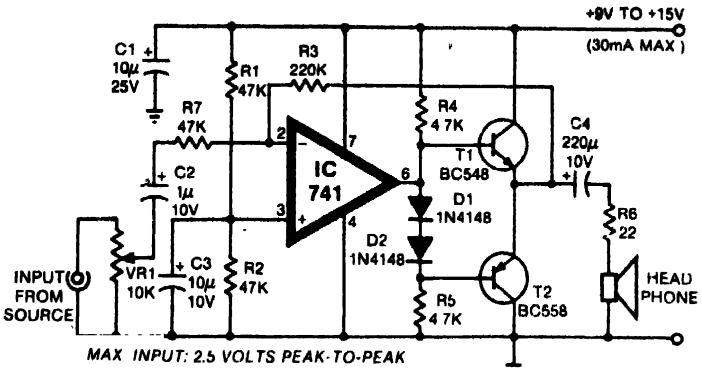
E. AUGUSTINE

Headphone Amplifier

A number of tape recorder preamp circuits have appeared in this magazine in the last few years. All of them have just one thing lacking– that is a good headphone amplifier circuit. This circuit attempts to provide just that. The circuit is suitable for headphones of 8-ohm or more impedance with no risk of overloading or distortion of either the circuit or the phones.

The circuit is self-explanatory for the experienced hobbyists and performs its task with a minimum number of components. The op-amp is used to provide suitable gain (determined by the ratio R3/R7), while the transistors are used to supply the higher currents required to drive low-impedance phones. Diodes D1 and D2 provide proper biasing of the transistors to reduce crossover distortion. Capacitor C4 determines the low frequency response of the amp and is chosen to give lower cut-off frequency of about 20 Hz with an 8-ohm load.

The input of the circuit is connected to the tape preamp circuit output (or any other source delivering 100 mV to 2.5V peak-to-peak and having very high output impedance). As it has a relatively high input impedance (47k), it should not load the preamp circuit. Volume control VR1 is kept at minimum position and is increased till sufficient output is heard in the headphones. The potentiometer is then kept at



MAX INPUT: 2.5 VOLTS PEAK-TO-PEAK

this level. In case even with the potentiometer at the maximum level the output is not sufficiently high—increase the value of R3.

The circuit is powered from a 9V-15V supply and the existing supply of the preamp can also be used.

For stereo reproduction two such units will evidently have to be constructed.

The circuit also finds use as a high quality signal tracer if the output is connected to a speaker.

VIVEK MEHRA

Latch Circuits Simplified

In October 1985 issue of EFY a circuit with similar heading was published. The circuit presented here is much simpler, since it uses only one transistor. But a DPDT relay is used, as in most cases the size of a single-contact and a double-contact relay is more or less the same, even though there is a little difference in cost.

Transistor T1 (AC128) is a germanium pnp transistor which is used to actuate the relay. Under normal conditions, when push-to-on switch S1 is not pressed, the transistor does not get its bias voltage, and hence its collector is at -6V. When S1 is pressed, T1 gets its bias voltage via R1 and gets saturated, bringing its collector voltage to ground potential. Hence the relay gets actuated. Now even when S1 is depressed the transistor gets its bias through one pole of the relay. The relay gets deactuated when push-to-off switch S2 is pressed interrupting the supply voltage.

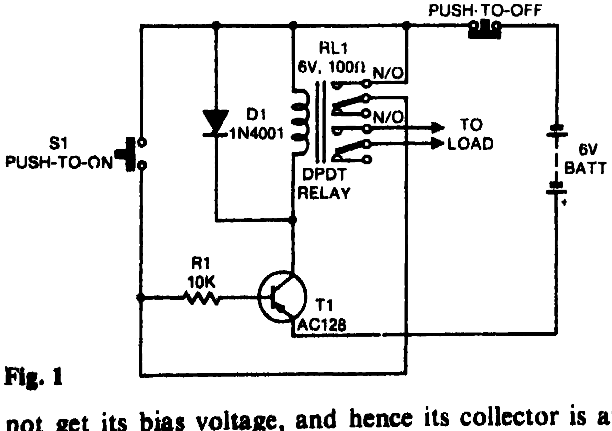


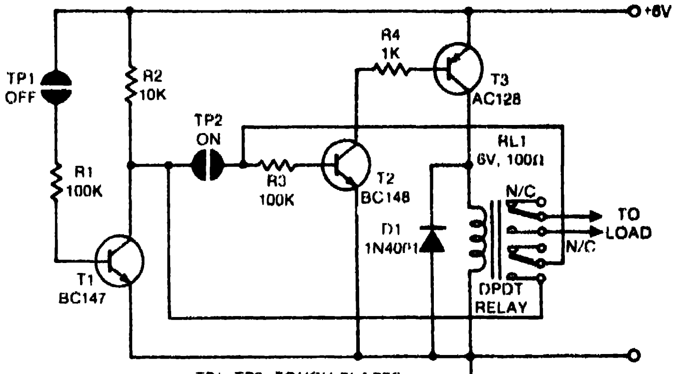
Fig. 1

The other pole of the relay can be used to control the load. Diode D1 (1N4001) protects the transistor from the back emf induced in the relay coil while deactuating.

Those who need an electronic latch circuit with touch sensitive switches may refer Fig. 2. Instead of push-to-on and push-to-off switches, a touch-sensitive switch has been incorporated here.

The touch switch can be made with two semicircular copper strips placed 2-3 mm apart. Under normal conditions, T2 does not receive its bias and so it doesn't conduct. Hence the relay is not actuated. When touch plate TP2 is touched, T2 receives its bias via R2 and R3 and resistance of the finger, and conducts. Then T3 also conducts, actuating the relay.

Once the relay gets energised, the bias to T2 is maintained via its one pole. Now when touch plate TP1 is touched, T1 gets its bias (till now T1 was not conducting) and conducts, bringing its collector to ground potential. Since T2 gets its bias via R2, the collector load of T1, now T2, does not get its bias-- bringing its collector to +6V. Hence the relay deactuates. Once again touching TP2 actuates the relay, and so on.



TP1, TP2 TOUCH PLATES

Fig. 2

Note: When only one half of touch plate TP2 that goes to the base is touched, the AC hum picked by our body is fed into the transistors. Due to this a current of about 15mA flows through the relay. Since the relay cannot get energised by this current, a hum is produced. So please see that both sections of the touch plate TP2 are touched simultaneously.

For both the above circuits the author used a 6V DPDT relay with a coil resistance of 100 ohms.

V. SURESH

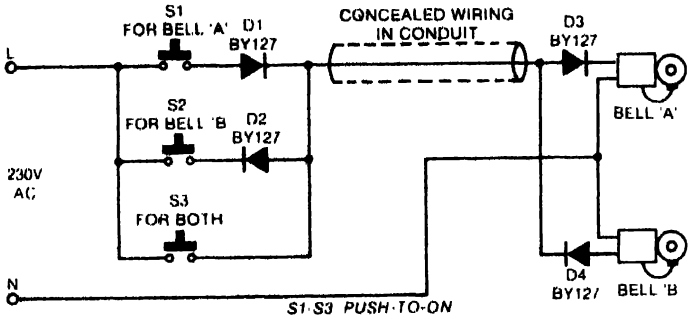
Two-Way Remote Call Bell

People living on the first floor and above in apartment houses find it convenient to install an extra bell-push on the ground floor so that they can be called by vendors, community telephone attendants and others from the ground floor without having to climb all the stairs. Usually this is done simply by extending a pair of wires from the terminals of the bell-push provided on the switchboard just outside the main entrance to the flat and providing another pushbutton switch in parallel at some convenient location on the ground floor.

Though simple to install, this has a disadvantage that the same bell rings from either bell-push and from the sound it is not possible to tell which switch was operated. Thus when the bell rings one cannot know whether to go to the balcony to speak to the caller or to open the door for the visitor.

Bells or buzzers with different tones are quite inexpensive and many a people wouldn't mind installing two bells for two pushbuttons, but this involves an extra wiring in the house for the second bell-push and bell. In most modern flats the wiring is concealed, a bell-push is provided outside the main door and a ceiling rose at some central place in the house where the bell is connected. Extra pair of wiring for the second bell has to run on wooden battens fixed on the wall and this makes an eye-sore. Hence most people avoid use of a second bell.

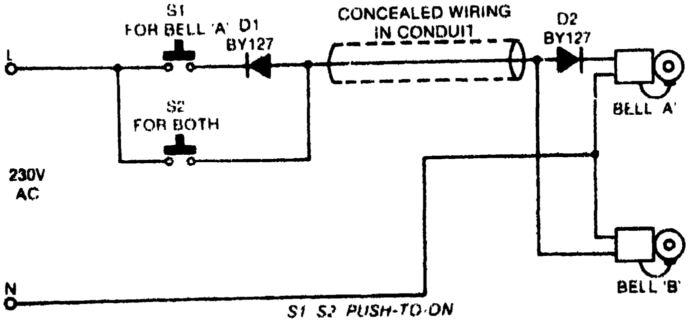
Using the circuit given here it is possible to ring two bells independently from two pushbuttons yet using the single-circuit concealed wiring provided at the construction time. As shown in Fig. 1, diode BY127 is introduced in series in each switch but in different directions. Both the bells are connected in parallel from the common ceiling rose and another diode is connected in series in each bell. When any bell-push is pressed, only that bell rings for which both the diodes are biased in the same direction.



S1-S3 PUSH-TO-ON SWITCHES
BELL 'A', BELL 'B' 230V AC BELL

Fig. 1

Even three-point signalling is possible by adding a third bell-push without any diode which, when pressed, will ring both the bells together. If necessity of a third point is not expected then you can save the cost of two diodes by using the circuit given in Fig. 2. In this case, when S1 is pressed only bell B rings while a push on S2 rings both the bells together.



S1 S2 PUSH-TO-ON SWITCHES
BELL 'A' BELL 'B' 230V AC BELL

Fig. 2

The circuits should be used only with the bells or buzzers which operate directly on 230V AC. It should not be used with electronic novelties which operate on low voltage DC through a step-down transformer, because a diode in series in the primary of the transformer will result in a very low RMS voltage on secondary side.

(MRS) MADHURI C. PANDIT

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Do you have any circuit idea which you feel is worth sharing with the other EFY readers? If so, please do put it down neatly on a piece of paper and mail it to:

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A token honorarium (minimum Rs 50) will be paid for the ideas found acceptable for publication. But please see that your contribution fulfils the following two conditions:

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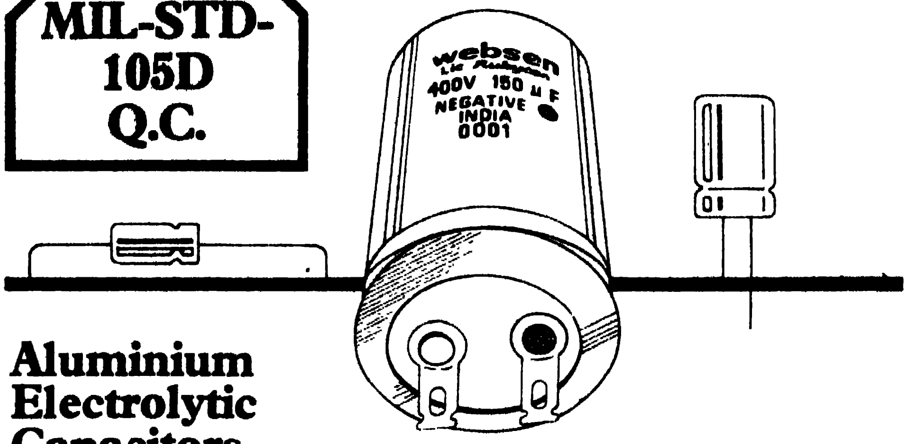

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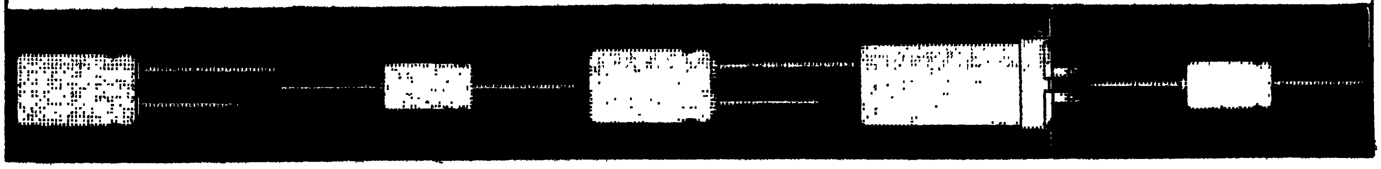

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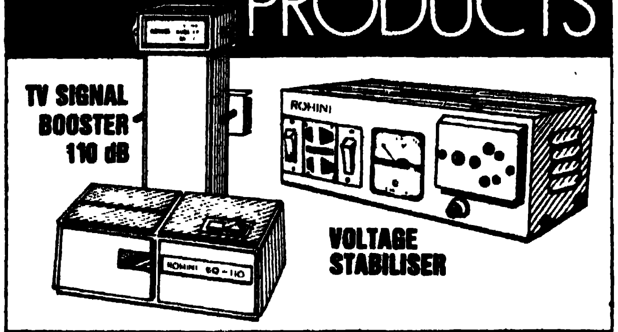

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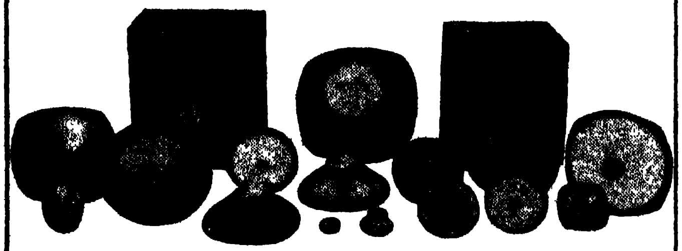

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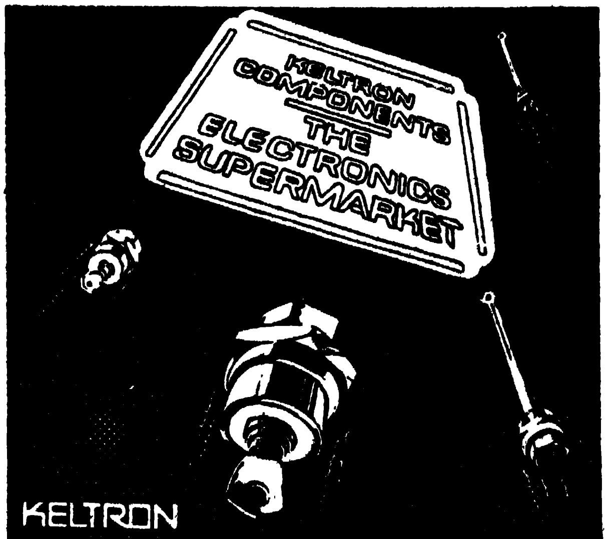

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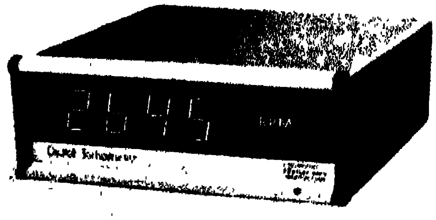
DIGITAL TACHOMETER

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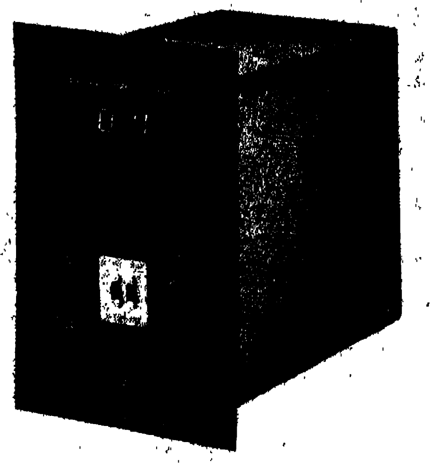
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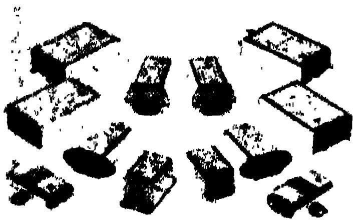

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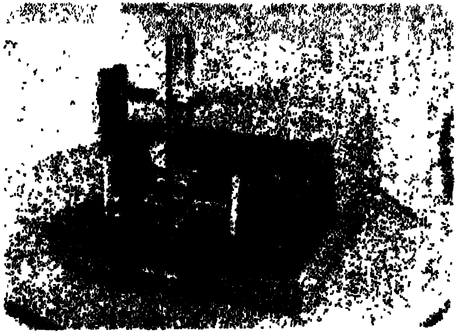

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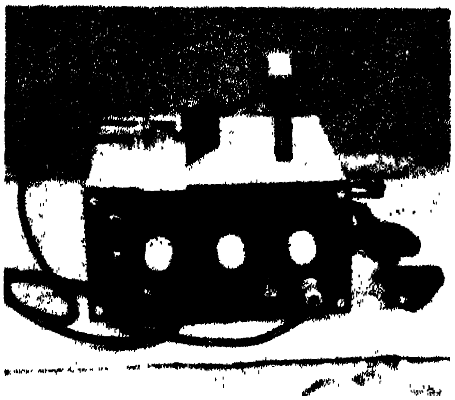

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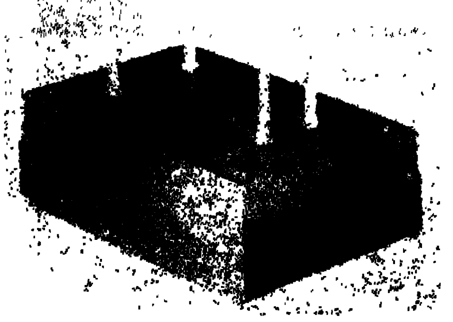


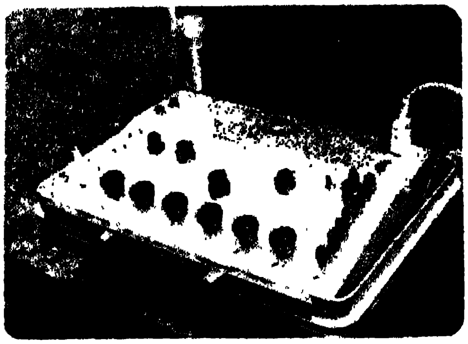
SOLIDSTATE RELAY

Contact: Electronic Relays (India) Pvt Ltd, No. 34/1-A, Ist Main Road, Gandhinagar, Bangalore 560009.

4-CHANNEL MIKE-AUDIO MIXER

EDI has introduced a professional solidstate Mike-to-line Mixer Amplifier model OBA-104Hx for field/studio broadcast, recording or PA systems.

The amplifier works on 220V, 50Hz or 12V dry batteries with an automatic changeover on power failures. It has a gain of 90 dB or more with a response of +1dB 50 Hz to 10kHz. It has a distortion of less than 1% THD and sound to noise ratio of 50 dB.



4-CHANNEL MIKE-AUDIO MIXER

The amplifier's facilities include a test tone generator and VU meter monitoring.

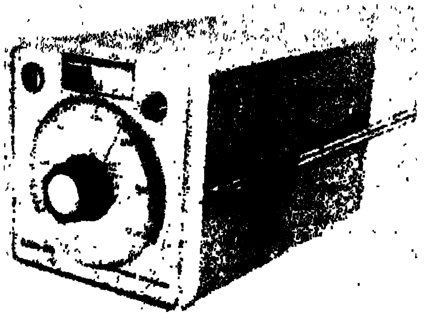
Contact: Electron Devices India, J-13A Kailash Colony, New Delhi 110048.

TEMPERATURE CONTROLLER

ESD-80 is a solidstate, ON/OFF set point Controller for controlling various process parameters like temperature, pressure, flow, level, pH etc.

It accepts signal from thermocouples, resistance bulb, and any other current or voltage signal from transducer or transmitter. The input signal generated by the transducer is compared with highly stable built-in reference set point and triggers relay to its off condition when input parameter exceeds set point. A lamp on the front indicates relay condition.

Cold junction compensation and thermocouple break protection, are standard features and the relay remains in off condition in case of break in input circuit. Due to high input impedance amplifier, no lead resistance



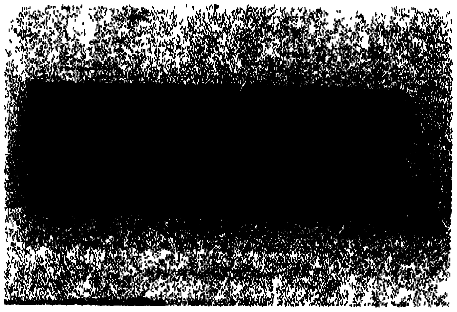
TEMPERATURE CONTROLLER

adjustment is required. This series is designed using solidstate IC circuit to give trouble-free, long-life service.
Contact: Electronics Systems & Devices, 38-39/7 Hadapsar Indl Estate, Pune 411013.

DIGITAL WALL CLOCK KIT

This Wall Clock from Elektro World based around MM clock IC is suitable for auditoriums, railway platforms, large rooms, office/factory, halls and lobbies, home etc.

A large PCB accommodates all the components except the mains power transformer and the cabinet mounted switches. As a wall clock the only facilities you are likely to use are the fast and slow set switches. However, other facilities like alarm, snooze, timer, seconds display, etc may be easily added without any difficulty. Hours and minutes are separated by flashing dots. Battery back-up is provided to cope with loadshedding.


DIGITAL WALL CLOCK KIT

The kit contains all components (clock IC, divider IC, crystal, 40-pin IC socket, resistors, electrolytic, disc and trimmer capacitors, 103 low current extra bright LEDs, diodes, suitable power transformer, large PCB, fast set and slow set pushbuttons plus a detailed manual containing circuit diagram, component layout on PCB, construction details, etc enabling complete assembly.
Contact: Elektro World, 48/B Harpal Nagar, Moradabad 244001 (UP).

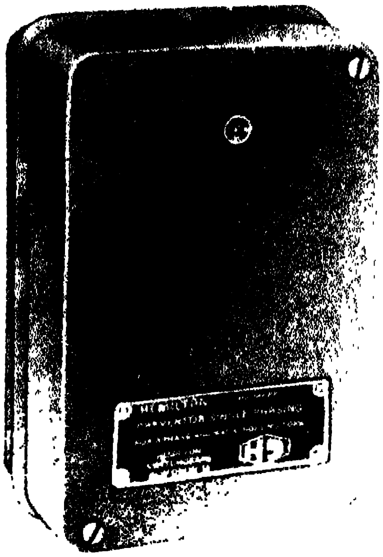
CANAL HEARING AID

Hearing Aid Centre has introduced the Canal Hearing Aid for the first time in India. This hearing aid (invisible) can be totally concealed in the ear cavity, thus avoiding embarrassment to the user. It can give up to 45 dB gain but can cover hearing loss up to 80 dB. It has a battery life up to 200 hrs, using 312 watch battery. It has a frequency response of 200-5000 Hz.
Contact: Hearing Aid Centre, Kailash Cinema Chowk, Civil Lines, Ludhiana.

SINGLE PHASING PREVENTERS

Hemilton Switchgears have designed a phase failure relay of voltage sensing type actuated by negative phase sequence component of voltage.

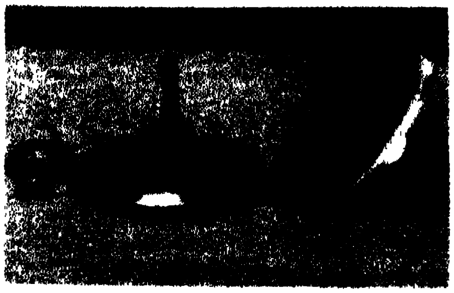
The most significant feature of this design is that it requires no auxiliary power supply. The relay remains de-energised under normal conditions. It is triggered only in the event of single phasing, reverse phasing, under/high voltage (adjustable) or voltage unbalance Hence the life of the relay is much longer than the life of the motor itself. It is fully solidstate, using two ICs and has a motor 'on' LED indicator.
Contact: Hemilton Switchgears, Chamber 315 (III Floor), 4/1 D.B. Gupta Road, (Near New Bank of India), Pahar Ganj, New Delhi 110055


SINGLE PHASING PREVENTERS

DISCS WITH HOLDER

For the first time in India Disposable Discs With Holder are indigenously developed by Imexsu (India) with technical knowhow and raw material from the Fibral Organisation, UK.

These discs (dia. 75 mm) are made from imported low-density, three-dimensional throughout impregnated abrasive with controlled cutting action, formulated for surface preparation, finishing, cleaning and micro-deburring. The important features are: less down time, increased production, replaces traditional preparation and finishing materials, is highly flexible, conforms to irregular surfaces, is self-dressing, provides controlled stock removal, and is non-clogging and non-metallic.


DISCS WITH HOLDER

These discs easily fit holders without using any tools by positive mechanical locking within fraction of a second. Holder having 6 mm diameter spindle can be mounted on any portable/stationary tools/machines available locally or imported. Changing discs does not require removing holder from tools/machines. Discs available in four types: (a) plain disc, (b) spirally wound, (c) flaps, and (d) puma.
Contact: Imexsu (India), 6-A Vaibhav Industrial Estate, Saki Vihar Road, Sakinaka, Bombay 400072.

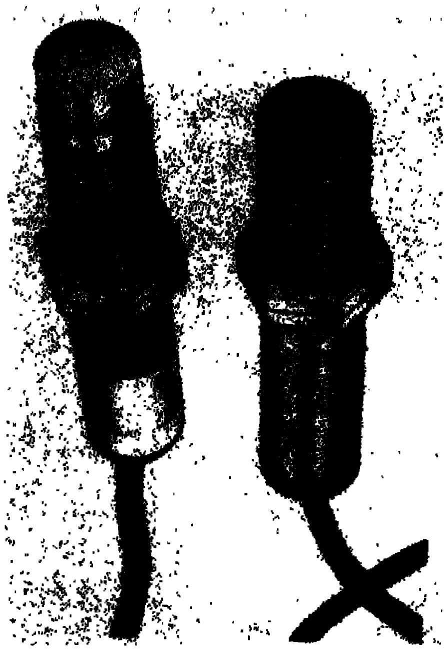
MICRO SWITCHES

Archer's Micro Switches are manufactured in the nylon filled bakelite casing with contacts made of silver For providing complete insulation Delrin moulded brackets can be fitted to the switches Operation force required is 250 gms and releasing force is 125 gms for normal action Operation force for light action is 125 gms and releasing force is 65 gms. Plunger can travel when depressed to the level of switch case. Pre-travel distance is 0.6 mm to 1.2 mm Movement differential is 0.1 mm to 0 2 mm Resistance rating at 220V is 10 amp for normal action and 5 amp for light action
Contact: Impala and Archer Electronic Corporation, 17 Oasis Industrial Estate, Opp. Vakola Masjid, Nehru Road, Santacruz (E), Bombay 400055.

INDUCTIVE PROXIMITY SWITCHES

IEC has recently introduced a line of Inductive Proximity Switches These are basically contactless limit switches and can be used wherever conventional limit switches are currently used. In addition, they feature applications like high speed counting where the performance of limit switches would fall short.

These sensors feature solidstate circuitry with no moving parts—no arms, no levers, no rollers. Consequently, problems like roller breakage, contact bounce, etc that are com-


INDUCTIVE PROXIMITY SWITCHES

mon in the case of limit switches can be conveniently avoided. Moreover, their encapsulated construction makes these sensors resistant to the action of oils, acids, coolants, vibrations, etc. Sensors are available in both AC and DC versions with sensing ranges from 5 to 20 mm. The AC version can be used to count up to 5 parts/sec, while the DC version can be used for up to 200 parts/sec.
Contact: Indian Engineering Company, Katara Mansion, Post Box 16551, Worli Naka, Bombay 400018.

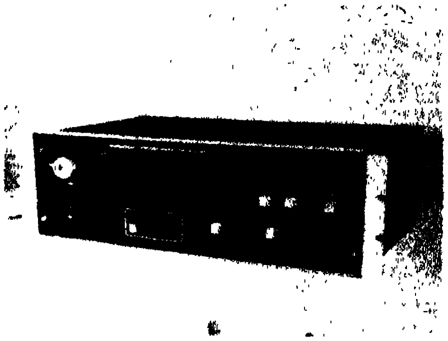
COLD ROLLING MILL CONTROL SYSTEM

A unique microprocessor based Cold Rolling Mill Control System for tension control, reference distribution, computations, auto-slow down and fault detection has been introduced by Larsen & Toubro Limited.

This system is used for rolling non-ferrous foils of up to 0.05 mm thickness at a mill speed as high as 300 metres per minute, accelerating in 20 seconds. Tension accuracy of the mill up to 0.5 per cent, speed holding accuracy up to 0 1 per cent and auto-slowdown up to ± 42 mm have been achieved with this unique system. A variety of protection features and operator controls and display are also included in the thyristorised DC drive and control system, which has been successfully commissioned
Contact: Larsen & Toubro Limited, (L-CON Division), L&T Powai Works, Saki Vihar Road, P O. Box 8901, Bombay 400072.

DIGITAL TEMPERATURE PROGRAMMER

Masibus has developed a microprocessor-based Temperature Programmer to carry out a simple time *vs* temperature profile up to 99 steps, obsoleting conventional cum type programmers. As an option, the programmers are available to store up to 10 programs. Each program can have a different time *vs* temperature profile up to 10 steps. The steps can be programmed in any sequence of ramp-up, soak or ramp-down. The ramp rate can be programmed for 0 to 999 digits/hr and the soak set point up to 0 to 1999 digits (limited by the temperature sensor used). Soak time can be set for 0 to 1440 minutes per step. There are two sets of digital displays, one for the actual process temperature with an accuracy of 1°C, and the other for the set point and remaining soak time. The program status is preserved on mains failure, by battery backed up RAM. At the end of program, the programmer resets to zero and power is switched off to the heater. As an option, the final set point may be held until the programmer is manually reset


DIGITAL TEMPERATURE PROGRAMMER

Additionally, the programmer has a built-in proportional controller with adjustable cycle time and proportional band. A relay output with NO, C and NC contacts of 2 amps rating is provided for operating an external contactor. The controller input is factory calibrated for any one of the seven standard industrial thermocouples (B,E,J,K,R,S and T) or RTDs in three or four wire configuration. Automatic cold junction compensation is provided for thermocouple types. As an option, presettable interrupt timer can be provided, to switch off control relay and wait for operator intervention, if the mains fails for more duration than the preset time. Thumbwheel programming flexibility makes the programmer highly versatile. Digital set point generation and digital readouts give high stability, accuracy and performance. Application areas identified are heat treatment, stress relieving, ceramics etc.
Contact: Masibus Electronics, L-128 GIDC Estate, Odhav, Ahmedabad 382415.

DIGITAL CLAMP TESTER

MECO has introduced a fully electronic Digital Clamp Tester model 2200 having a large, 3.5-digit LCD for easy reading for the first time in India. Housed in an attractive and tough ABS plastic housing, its auto ranging on all functions eliminates the need to change ranges. It has data-hold function which is useful in taking reading in dark places or in dangerous locations.

Regardless of conductor position, highest accuracy (±1.2 per cent ±5 dgt for current, 1.0 per cent ± dgt for voltage and ± 0.7 per cent ± 3 dgt for ohms measurement) is assured by use of round clamp head with balance coils. This tester measures current up to 1000A, voltage up to 1000V and resistance up to 2 kilohms. Its data-hold switch freezes readings when required. Continuity buzzer and low battery indication is also provided.
Contact: Meco Instruments Pvt Ltd, Bharat Industrial Estate, T.J. Road, Sewree, Bombay 400015.

DIGITAL CLAMP TESTER

KEYBOARD WITH NUMERIC PAD

Micro Power produces Keyboard with Numeric Pad. This two-key rollover full ASCII keyboard has 71 keys. The system operates in five modes—normal, upper case, lower case shift, control and shift control. It has direct provision of selecting even or odd parity with normal or complementary data and TTL/tristate option for direct connection to microprocessor systems with a data ready signal. The system requires a +5V supply.
Contact: Micro Power, 14 Nelayam Society, Tapowan Ashok Road, Pimpri, Pune 411017.

KEYBOARD WITH NUMERIC PAD

EPROM EMULATOR

Emulex-24 from Microaids allows microprocessor engineers to concentrate more on software and system performance. Use of Emulex avoids need of EPROM programming till final tested software is fully ready. One has to replace system EPROM by Emulex header and put EPROM in ZIF socket on Emulex. The unit is also equipped with two RAMs.

EPROM EMULATOR

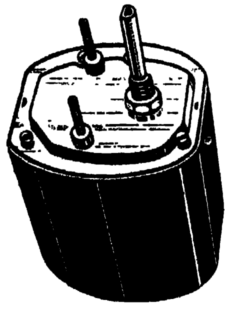
The user can enter new programs or modifications in these RAMs in machine language through Emulex keyboard. The user gets flexibility to devote either of the three memories to prototype processor, under Emulex keyboard control. Emulex can emulate online and program 2716, 2732, 2816 for any 8-bit processor. The unit also offers convenient

editing instructions along with a bilateral cassette port to facilitate intermediate storage.
Contact: Microaids, 769/7 Arunodaya, Deccan Gymkhana, Pune 411004.

DC SERVO MOTORS

P B Aum Engineering Co. offers DC Servo Motors for use in servo controlled voltage stabilisers.

The motors are designed to deliver a very high torque: minimum 10 kg/cm at 12 volts. They are rugged in design, tough, very economical, and have a very good life. They are rated at 12V DC with a speed of 60 RPM.



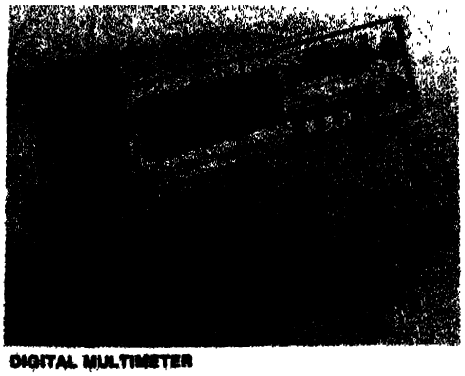
DC SERVO MOTORS

Rotation is bidirectional, with instant reversibility. Current rating maximum 1.25 amps. No load current is 0.8 amps; torque at 4 volts, 6 kg/cm. The above motors can also be used with an AC supply of 230 volts, with a rectification system which can be supplied at a very little extra cost.
Contact: P B Aum Engineering Co., B2/1 Premji Nagar, Borivili (E), Bombay 400066.

DIGITAL MULTIMETER

A 4½-digit autoranging Digital Multimeter 2650 from Systems Dimensions, with LCD in play with sampting hold function can measure 20 ranges in five different modes. Using this instrument we can measure DC voltage, AC voltage, resistance, DC current, AC current up to 0.03 per cent basic DC V accuracy.

It also offers some special functions like diode check and beeper function. The most important advantage of this equipment is its compact size and weight with battery. It operates on the principle of dual slope integration and has a sampling rate of 2.5 times per second. If the measuring range falls in average it will start blinking. If the battery power falls below 6.0 pv "B" will be displayed.



DIGITAL MULTIMETER

Contact: Systems Dimensions, 24 Ist 'R' Block, West of Chord Road, Rajajinagar, Bangalore 560010.

LCR METERS

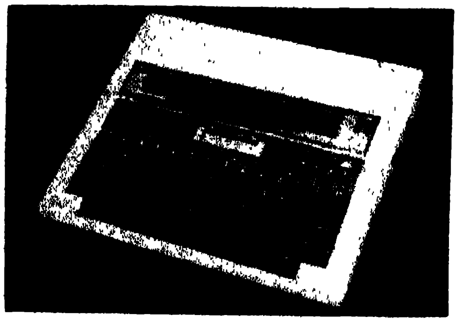
Ando Electric Co Ltd, Japan offers AG-4301B and AG-4303 digital LCR meters. These are designed for measuring circuit components quickly with high accuracy. A new measuring technique used features ease of operation and excellent stability. Measurement and display of L,C,R,D and Q is possible over a wide measurement range and at two selectable measurement frequencies. An exclusive jig and test leads are available for accurate measurements using the five-terminal connection method.

Other features include residual charge protection up to 50V, capability of superimposing up to 30V DC and ability to function as a system component in test system and automated through the use of plug-in GPIB and BCD interface options.
Contact: Murugappa Electronics Ltd, Agency Division, Tiam House, 28 Rajaji Road, Madras 600001.

ELECTRONIC TYPEWRITER

Silver Seiko Ltd, Japan has introduced a revolutionary Electronic Typewriter (the Silver Reed Colour Pengraph EB 50) in India.

This versatile writer/plotter with a four colour rotating ball pointed pen writing head provides a convenient means of creating clear and colourful combinations of texts and visuals. It is possible to generate graphs such as concentric pie charts, bar graphs, line graphs with or without point marks and layout charts. In total, 12 kinds of graphs are available in three print sizes. A calculating function takes care of all figure work. The built-in Centronics interface increases its versatility by making it a convenient graphic printer for hooking with personal computers.



ELECTRONIC TYPEWRITER

An ideal typewriter for personal use, it allows printing text in courier and italic style letters. For added user convenience, a 5×7 dot matrix liquid crystal display of 16 characters is incorporated. An one-line correction memory enables easy insertion and deletion of matter. Automatic underlining is also available. The printing colours are black, red, green and blue. Printing in three directions (left-right, bottom-top and top-bottom) is possible. With the printing speed of 14 characters per second, it has 1.2 mm printing pitch and 160 characters per line. The paper width is 220 mm and the printing width is 192 mm. It measures 322 mm × 267 mm × 57 mm and weighs only 2.5 kg.
Contact: Usha Computers and Peripherals Ltd, BII/I Mohan Co-operative Estate, Sher Shah Suri Marg, New Delhi 110044.

OXIDISED COATING

The adherence and thermal endurance of inner-layer copper surfaces in multilayer printed-circuit boards (PCBs) can be boosted by means of an oxide process developed in Britain. Called 'Slotox' this dark-bronze-coloured Oxide Coating increases the peel strength of the copper tracks to about 0 45 Nm (4 lbf/in) typically. However, under certain operating conditions, the peel strength can be increased to as high as 0.90 Nm (8 lbf/in)

Slotox prevents the catalytic production of gas pockets within the bond, eliminating the risk of delamination occurring at elevated temperatures or in the subsequent solder-reflow process. The colour-consistent oxide coating is applied to the inner layers following a rigorous precleaning sequence, after which they go through cold-water and deionised-water rinses before being oven dried at 80-110°C for 30 minutes

Life of the Slotox bath is 3-4 weeks at working temperature, which for dipping is 68-75°C and for spraying 65-70°C Bath loading is 0.5 dm²/litre, while dipping time is 7 minutes (4-8 minutes) and spray 3 minutes (2-4 minutes). For dip coating mild work agitation of 4 m/minute is recommended.
Contact: Schloetter Company Ltd, Abbey Works, New Road, Pershore, Worcs, England WR10 1BY.

PROGRAMMABLE TELEPHONE ANSWERING MACHINE

Dictaphone Corporation has introduced the Model 789 II Programmable "question and answer" Telephone Answering System with the capability to record one and half hours of incoming messages. It is particularly suited to order entry and information gathering applications. Its recording capacity may be expanded from one and half to over seven hours utilising other dictaphone voice processing systems.

The system uses C-60 or C-90 standard cassette tapes to record incoming voice communications. The announce message may be customised by the user and the machine programmed for a specific information gathering task. Information may be transcribed from the dictaphone model 2878 standard cassette transcriber.

Applications particularly suitable for model 789 II machine are order entry in sales and catalogue businesses, telephone transfer and bill payment in banking, teacher absence/substitute scheduling in education, patient admissions in hospitals, claim initiation in insurance, and customer contacts in business services organisations.
Contact: Dictaphone Corporation, 120 Old Post Road, Rye, New York 10580, USA.

LEADER

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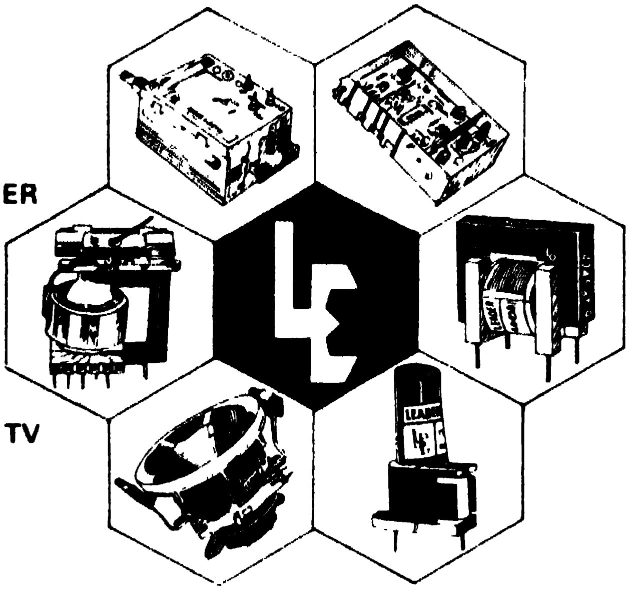
- EHT TRANSFORMERS (ALL MAKES)
- DEFLECTION YOKE
- LINE-DRIVER TRANSFORMER
- LINEARITY COIL
- TUNER
- V.I.F. BOARD
- BOOSTER
- MAIN TRANSFORMER FOR TV



FOR DETAILS CONTACT

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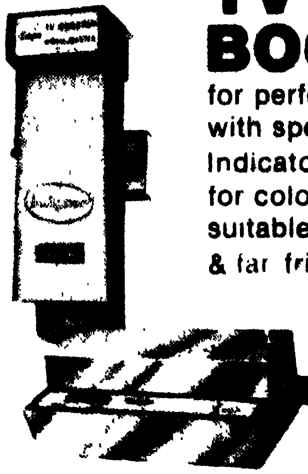

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INTERFACE BOARDS

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RS232C type Serial interface with 2K Memory
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RS232C type Serial interface board for GP700A Colour printers

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Company Profiles

All-round growth for Teletronix

Teletronix Limited, Bhimtal, a UP government undertaking producing TVs, radios, radio paging systems etc with a sales turnover of Rs 46 90 million has earned a record profit of Rs 3 5 million in the year 1985-86 compared to the accumulated profit of Rs 18 million in the last year This is indeed remarkable especially since its very inception in the year 1973, the company was running in loss which had swelled to Rs 2 5 million in 1983-84

Keeping in view the commissioning of a low-power transmitter in the Kumaon region, Teletronix, along with Kumaon Mandal Vikas Nigam, has decided to promote a new company, Kumtel, to produce colour TVs, two-in-ones etc with an authorised capital of Rs 1 million

Transcending these economic gains, the real success of Teletronix lies in changing Bhimtal into a modern electronics township Its success has encouraged Facit Asia, Choksi Bros and other industrial houses to establish their units in this otherwise unknown region To generate trained manpower for these industries, Teletronix has also been chosen by the government as a training centre

Hylam leads in laminate production

Bakelite Hylam, pioneer in the manufacture of industrial laminates, has achieved an annual capacity of 5800 tonnes—the largest capacity in the country

The company currently accounts for 70 per cent of India's industrial laminate exports and 40 per cent of the domestic requirement Its range in laminates include those based on paper, fabric, glass-epoxy, copper-clad and combinations thereof.

Bakelite Hylam exerts strict quality control tests not only to raw materials and production processes, but also to the finished laminates. The company's well-equipped R&D centre at Hyderabad works at indigenising imported technology to suit Indian conditions and has several innovations to its credit. Approved by the Department of Science and Technology, this is the only R&D centre of its kind in the country.

Al-Ameen commissions new plant

Al-Ameen Commercial & Industrial Company has commissioned an advanced plant for the manufacture of professional grade carbon and metal film resistors last month This is part of its many-faceted expansion programme

The company is also entering the capital market with a public issue of equity shares at Rs 10 each to raise financial resources to launch further projects for indigenisation of technology.

Al-Ameen has earlier achieved good results in the field of manufacturing, marketing and technical consultancy services

BEL process technology for private sector

Process technology for manufacture of two special high-purity electronic grade materials has been transferred by the public sector enterprise Bharat Electronics Limited (BEL) to private entrepreneurs Two agreements have been signed with parties from Faridabad and Calcutta

The indigenous technologies for the manufacture of silver paste compositions and special glass compositions have been developed for the first time in the country by the Materials Development Laboratory in BEL which has been set up with financial assistance from the Department of Electronics The development and the resultant transfer of technology to other entrepreneurs will make the country self-reliant in these materials apart from saving precious foreign exchange

Silver paste is used as electrode material in the manufacture of ceramic capacitors. The special glass compositions are for glass-to-metal seals required in the production of semiconductors. There are more than half a dozen parties manufacturing ceramic capacitors and semiconductors in the country who need these materials. These materials are presently imported by these manufacturers. The present requirement of silver paste to the tune of 500 kg per annum and of glass composition to the tune of 3 tonnes per annum are entirely imported.

The processes for manufacture of electronic grade ceramics have also been developed by BEL Negotiations with entrepreneurs are on for the transfer of process technology for these materials also These include high alumina ceramics, high-frequency low-loss steatite bodies and piezo-ceramic transducers

Venus Computers enters market

Venus Computers Limited recently entered the capital market with the public issue of 360,000 equity shares of Rs 10 each for cash at par to partly finance its expansion programmes

The company is poised for major expansion in the fields of data processing and software development It proposes to set up a new computer centre at Andheri, Bombay where it will have large volume data preparation facilities Besides, the company is in the process of acquiring latest fourth generation computers

Among its expansion plans, the company proposes to launch a chain of off-the-shelf retail shops for marketing all types of computers and their peripherals, robotronics, application and commercial software, and computerised telecom networks and systems This is expected to provide all facilities under one roof, at different places

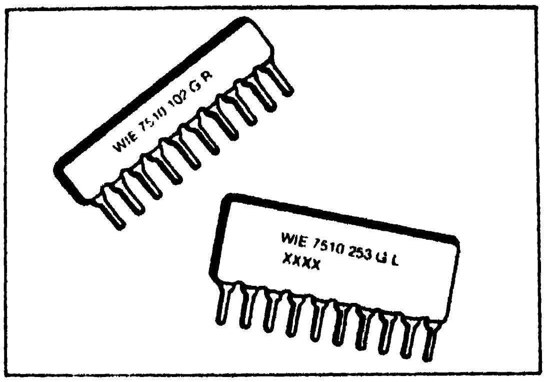
Hartron's computer installation services

The Haryana state government has approved the appointment of the Haryana State Electronics Development Corporation Limited (Hartron) as a nodal agency for computerising various government departments in the state.

Hartron has approached various potential users for utilising its services on a turnkey basis for the installation of computers or to get their data computerised. The turnkey services include finalisation of computer specifications, assistance in purchase of computer, site preparation, installation of computer systems, software development, training personnel etc.

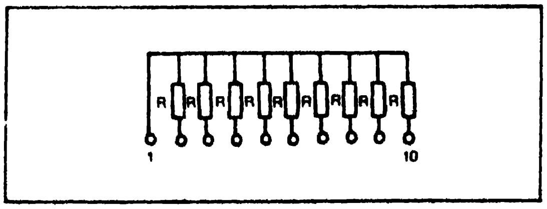
Hartron charges 10 per cent of the project cost as consultancy costs The charges for software development and training personnel of user departments are based on the manpower involvement of the corporation

WIE OFFERS THICK FILM RESISTOR NETWORKS



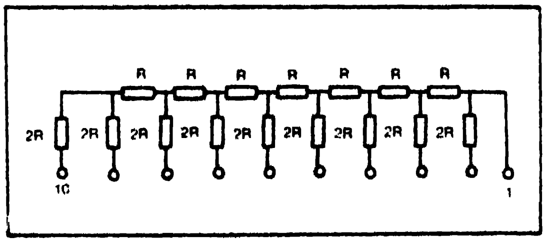
- Reduces PC Board Space and Circuit Complexity
- High Stability and Reliability
- Laser trimmed
- Conformally coated
- Low profile
- Meets MIL – R - 83401.

WIE RESISTOR NETWORK



- Standard Resistance Range
  22 Ohm to 1 Meg Ohm.
- Resistance Tolerance
  ± 5°, ± 2° (± 1° Special)
- Pull up/Pull down array for Digital circuits, Computers etc

WIE R/2R LADDER NETWORK



- Available 25K/50K, 75K/150K 100K/200K
- Resistance Tolerance. ± 2°
- TCR (tracking) down to ± 10 ppm/°C
- ± ½ LSB accuracy.
- 8 Bit precision ladder networks for A-D & D-A applications

Operating Temperature Range:	- 40°C to + 125°C
Rated Power	125 mW/element (70°C) (Derate linearly to 0 Watt at 125°C)
Maximum Working Voltage	50 V (Not to exceed rated power)
TCR	Standard ± 100 ppm/°C

For details, Contact.

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Electronics Division
Shashi Chambers. Pune Satara Road, PUNE 411 037
Tel No. (0212) 30370/30128 Tlx. 145-481, 145-221, 145-496

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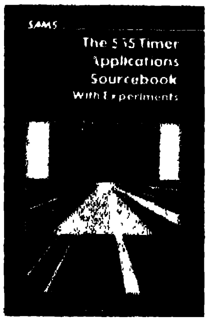
Book Reviews



The 555 Timer Applications Sourcebook

With Experiments

By Howard M. Berlin; published by B.P.B. Publications, Delhi by arrangement with Howard W. Sams & Co. Inc., USA (orignally published by E&L Instruments Inc.); pages 158 (14 cm × 21 cm); soft cover; price: Rs 27.

This book describes what the 555 timer is and how to use it—by itself and with other solidstate devices. Chapter one gives the timer's organisations and electrical characteristics, while chapter two describes how to connect this device as a monostable multivibrator or one-shot pulser. Next, chapter three describes the free-running astable multivibrator square-wave generator, without the use of expensive crystals. Chapter four illustrates the uses of this timer. In chapter five some useful and novel circuits are presented. The next four chapters are devoted to other useful applications including electronic games, telephone, and automotive circuits. Lastly, chapter ten allows one to gain basic practical knowledge using the timer. The book also contains 17 simple experiments to demonstrate many of timer's features and applications, which one can breadboard in a few minutes.

—R.G.

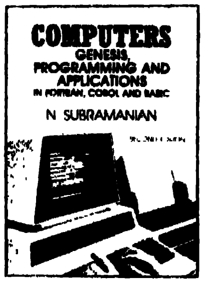
Beginner's Guide to TV Repair

By Homer L. Davidson; published by TAB Books Inc., USA; pages 272 (21 cm × 13 cm); soft cover; price: US $ 12.95.

In India, till about 1975 all TV receivers were B&W and used valves but gradually all-solidstate/hybrid receivers have emerged with the advent of transistors and ICs. Now, colour TV receivers have been launched with advanced TV technology. However, maintaining and troubleshooting these receivers is not so easy without deep practical as well as theoretical knowledge of TV technology. The book is divided into twelve chapters. Chapters one and two deal with the complete TV system theory such as basic sound and picture system, conversion of original sound/picture image to radio frequency, working principle of hybrid, solidstate and IC based receivers. Chapters three and four provide the theory of colour TV, how it works and working principles of the complex colour-only sections. Chapters five and six deal with introduction to troubleshooting using test equipment as well as trial and error method. Chapters 7, 8 and 9 are packed up with lots of basic troubleshooting information related to both B&W and colour TV sets. Last three chapters offer the theory of solidstate circuitry, their service problems and adjustments.

This book is a valuable source for theoretical and practical troubleshooting and repair guidance for beginners as well as established technicians.

—D.G.


COMPUTERS
GENESIS, PROGRAMMING AND APPLICATIONS
IN FORTRAN, COBOL AND BASIC
N SUBRAMANIAN

Computers

Genesis, Programming and Applications in FORTRAN, COBOL and BASIC (second edition)

By N. Subramanian, published by A.H. Wheeler & Co. Pvt Ltd, Allahabad; pages 456 (18 cm × 24 cm); soft cover.

Computerisation in all walks of industry and business has increased by leaps and bounds during the eighties, especially with the introduction of microcomputers in India. Though there are books which deal with either computers or programming, it is still difficult to come across a book which explains both. This book gives an account of both hardware and software for computers.

Starting with an introduction to the structure of a computer system, the author gives an outline of the available machines which can be attached to the CPU. Methods used to analyse a problem prior to writing a program are given in a separate chapter. FORTRAN being the major language for scientific and engineering computations, it is described over four chapters. A chapter each is devoted on COBOL and BASIC. Separate chapters explain the applications as well as computer graphics and plotters. A new chapter on computer arithmetic has been added in the second edition. The book will prove invaluable for readers who want to write programs but have no previous knowledge of electronics.

—R.B.

LICENCES AND LETTERS OF INTENT

The following licences and letters of intent were issued to electronics firms under the Industries (Development & Regulation) Act, 1951 during the months of December 1985 and January 1986.

Name & Address of the Applicant and Location of the Undertaking (1)	*Date & Type of Licence* (2)	*Article* (3)	*Quantity per Annum* (4)
LICENCES			
Indian Duplicator Co Ltd 114 Dr Lal Mohan Bhattacharyajee Road Calcutta 700014 (Distt Nasik-Maharashtra)	9.12.85 (NA)	Electronic stencil cutting machines	1200 nos
DCM Ltd (Unit DCM Data Products) Bara Hindu Rao, Delhi 110006 (New Delhi-UT of Delhi)	10 12 85 (SE)	Mini/microprocessor based systems	Rs 115 million (after expansion)
Godrej & Boyce Mfg Co (P) Ltd Lakshmi Ins Building, Asaf Ali Road New Delhi 110002 (Distt Bombay-Maharashtra)	10.12.85 (NA)	1 Dot matrix printers/daisy wheel printers 2 Video graphic terminals/monitors 3 Computer keyboards	5000 nos 5000 nos 5000 nos
Jupiter Radios (Regd) Village Pawa, G T Road Distt Ludhiana Punjab (Distt Ludhiana-Punjab)	11.12.85 (NA)	Colour TV receiver sets	100,000 nos
Remington Rand of India Ltd 3 Council House Street Calcutta 700001 (Distt Faridabad-Haryana)	12 12 85 (NA)	Electronic typewriters	5000 nos.
AFCO Industrial & Chemicals Ltd 9 Wallace Street, Fort Bombay 400001 (Bombay-Maharashtra)	12.12.85 (COB)	1. Battery chargers 2 Voltage boosters/regulators, automobile voltage regulators 3. Inverters 4. DC-DC converters	Rs 14 million Rs 850,000 Rs 2.4 million Rs 250,000
O/E/N India Ltd P.B No 2, Vyttila Cochin 682019 (Bangalore-Karnataka)	19 12 85 (NU)	1 Keyboard/push-button switches 2. Relays	1 million nos 500,000 nos
United Diamonds Ltd 'United House' 107-110, Sector 17-B Chandigarh (Distt Raisen-Madhya Pradesh)	19.12.85 (NU)	1 Black-and-white TV sets 2. Colour television sets	50,000 nos 50,000 nos
Assam Electronics Development Corpn Ltd Industrial Estate, Bamunimaidan Guwahati (Guwahati-Assam)	19 12.85 (NU)	1 Black-and-white TV receiver sets 2 CTV receiver sets	100,000 nos 50,000 nos
Dynavision Ltd Near Dr Vikram Sarabhai Instronic Estate Kottivakkam Madras 600041 (Distt Chingleput-Tamil Nadu)	26.12 85 (SE)	Black-and-white television receiver sets	80,000 nos (after expansion)
DCM Limited (Unit: DCM Data Products) Vikrant Tower, 4 Rajendra Place New Delhi 110008 (New Delhi-UT of Delhi)	31 12.85 (NA)	Axle counters/detectors	409 nos.
The Gramophone Co. of India Ltd 33 Jessore Road, Dum Dum Calcutta 700028 (Distt 24 Parganas-West Bengal)	31 12.85 (NU)	Audio magnetic tapes	1000 MRM (84mm equivalent)
Indian Duplicator Co Ltd 114 Dr Lal Mohan Bhattacharyajee Road Calcutta 700014 (Distt Ranga Reddy-Andhra Pradesh)	31 12 85 (NU)	Plain paper copiers	5000 nos.
Hindustan Instruments Ltd 975, Sector-14, Urban Estate Gurgaon 122001, Haryana (Distt Gurgaon-Haryana)	31 12.85 (NA)	Magnetic ink character recognition (MICR) encoding devices	1000 nos
Allen Wood Roffee & Co India (P) Ltd 112A Chiranjiv Tower 43 Nehru Place New Delhi 110019 (Faridabad-Haryana)	14 1.86 (COB)	Minicomputer/microprocessor based systems	Rs 30 million
Crompton Greaves Ltd 1 Dr V.B Gandhi Marg Bombay 400023 (Distt Dhar-Madhya Pradesh)	17.1.86 (NU)	Electromagnetic relays for control purposes	50,000 units
Fortran Cirkit Electronics Pvt Ltd 337-D/E, TTK Road Madras 600014 (Chingleput-Tamil Nadu)	20 1.86 (NU)	Printed circuit boards (a) Plated-through holes (b) Multi-layer	 8000 sq. mts 2000 sq. mts
M P Uni-Magna-Tech E-1/23 Arera Colony Bhopal 462016 Madhya Pradesh (Raisen-Madhya Pradesh)	21 1 86 (NA)	1. Body scanners 2 Ultrasound equipment (portable, gynee and cardiac)	24 nos 200 nos
Elpro International Limited Chinchwad Gaon, Pune 411033 (Pune-Maharashtra)	24 1.86 (NA)	Computerised numerical control systems and servo drives for machine tools	525 nos.
Elpro International Limited Chinchwad Gaon, Pune 411033 (Pune-Maharashtra)	27.1.86 (NA)	Varistors (voltage dependent resistors)	5 million nos.
LETTERS OF INTENT			
B N Ojha C-20 Hauz Khas New Delhi 110016 (UT of Delhi)	5 12.85 (NU)	1 CDS communication systems 2. Auto exchanges 3 Cage communication systems 4. Shaft signalling systems 5. Coal ash analysis systems 6 Environmental monitor systems 7 Production and status monitoring systems 8. Programmable logic conveyor control systems 9. CO monitoring systems 10. Truck despatch systems	10 nos 8 nos. 20 nos. 20 nos. 5 nos. 10 nos. 15 nos 10 nos. 3 nos. 3 nos.
DCM Ltd (Unit: DCM Data Products) Vikrant Tower, 4 Rajendra Place New Delhi 110008 (Meerut or Agra-Uttar Pradesh)	10.12.85 (NU)	Printed circuit boards	11,000 sq. mtrs

Name & Address of the Applicant and Location of the Undertaking	Date & Type of Licence	Article	Quantity per Annum
(1)	(2)	(3)	(4)
Rakesh Gandhi N-167 Panchsheel Park New Delhi 110017 (Any permissible area in UT of Delhi)	11 12.85 (NU)	Mini/microprocessor based systems	Rs 200 million
Vinod C Vashishth 4150 Camberlay Drive York-PA 17402, USA (Distt Udaipur-Rajasthan)	12 12.85 (NU)	Photovoltaic cells, modules and connected systems	1200 kW
A. Sriskandarajah 12 Inner Circular Road Kilpauk Garden Madras 600010 (Distt Chingleput-Tamil Nadu)	12.12.85 (NU)	Polycrystalline photovoltaic cells, modules and connected systems	2500 kW
Neelam Rajender Rao P Box No. 15164, Riyadh 11444 Saudi Arabia (Distt Nalgonda-Andhra Pradesh)	12 12.85 (NU)	Solar photovoltaic modules and systems	0.50 MW
Blue Star Limited Kasturi Buildings Jamshedji Tata Road Bombay 400020 (Distt Bangalore-Karnataka)	13 12 85 (NU)	Computer peripherals	Rs 250 million
Photophone Industries India Ltd 7 Saki Vihar Road Bombay 400072 (Distt Ghaziabad-Uttar Pradesh)	13 12.85 (NU)	Electronic test and measuring equipment/ instruments	2000 nos
Blue Star Limited Kasturi Buildings Jamshedji Tata Road Bombay 400020 (Distt Bangalore-Karnataka)	13 12 85 (NU)	Mini/microprocessor based systems including personal computers	Rs 300 million
G.G. Chowdhary Sanag Micro (P) Ltd 158 Jubilee Hills Hyderabad 500034 (Distt Nalgonda-Andhra Pradesh)	13 12.85 (NU)	Mini/microprocessor based systems	Rs 50 million
Veetirang Electronics Ltd Block No 3, 2nd Floor Botawala Building, 7/10-Horniman Circle, Bombay 400023 (Distt Bharuch-Gujarat)	13 12.85 (NA)	Black-and-white TV receiver sets	100,000 nos.
Sushil Ray 15-A/43 Western Extn Area New Delhi 110005 (Distt Rohtak-Haryana)	13.12.85 (NU)	CTV receiver sets	50,000 nos.
Electronic Systems Punjab Ltd B-81 Phase-VII, SAS Nagar 160051 Punjab (Distt Ropar-Punjab)	17.12 85 (SE)	Minicomputer/microprocessor based systems	Rs 150 million (after expansion)
Auto Controls Pvt Ltd 41-A New Delhi House 27 Barakhamba Road New Delhi 110001 (Any permissible area in UT of Delhi)	17.12.85 (NU)	Daisy wheel printers, dot matrix printers, line printers, letter quality printers, floppy disc drives and hard disc drives	Rs 100 million
UP Electronics Corpn Ltd 10 Ashok Marg, Lucknow 226001 (Distt Agra-Uttar Pradesh)	17 12 85 (NU)	Cordless telephones	Rs 30 million
Andhra Pradesh Electronics Devt Corpn Ltd Parisrama Bhavanam Basheerbagh Hyderabad 500029 (Hyderabad-Andhra Pradesh)	18.12.85 (NU)	Black-and-white television receiver sets	20,000 nos
Punjab Electronic Components Ltd A-28 Phase-VII, Industrial Estate SAS Nagar Punjab 160055 (Distt Ropar-Punjab)	18.12.85 (NA)	Monochrome/colour CRT data/graphic display monitors for computer application	10,000 nos
British Physical Laboratories India Ltd 84 Mahatma Gandhi Road Bangalore 560001 (Distt Gurgaon-Haryana)	19.12.85 (NU)	1. CTV receiver sets 2. Black-and-white TV receiver sets	30,000 nos. 10,000 nos
S.M. Ali Peerzada AL Maniaz Street, P.O. Chikhli Distt Bulsar, Gujarat (Distt Bulsar-Gujarat)	19.12.85 (NU)	1. CTV receiver sets 2. Black-and-white TV receiver sets	50,000 nos 30,000 nos.
Punjab Electronic Components Ltd A-28, Phase-VII, Industrial Estate SAS Nagar, Punjab (Distt Ropar-Punjab)	19 12 85 (NA)	1 CTV receiver sets 2 Black-and-white TV receiver sets	50,000 nos 10,000 nos
Andhra Pradesh Electronics Devt Corpn Ltd Parisrama Bhavanam, 8th Floor Basheerbagh, Hyderabad 500029 (Distt Ranga Reddy-Andhra Pradesh)	19 12 85 (NU)	1 PCM multiplex testers 2 PCM channel access switches 3 Bit error rate measuring sets 4 PCM line repeater testers and repeater checkers 5 Cable fault locators 6 PCM cable test sets 7 Level generators (600 kW) 8 Selective level meters (699 kW and 186 MHz) 9 Level metres (PMG-2-200 Hz) 10 Digital impulse senders 11 Accessories for testing such as attenuators, terminators, impedance transformers and connecting cables	2000 nos each
Electronics Research Pvt Ltd 17th KM, Old Madras Road Bangalore 560049 (Bangalore-Karnataka)	20 12 85 (NU)	Computer peripherals and electronic printers	Rs 130 million
Usha Microprocessors Controls Ltd Jeevan Tara Building 5 Parliament Street New Delhi 110001 (Distt Faridabad-Haryana)	20.12 85 (NA)	Modems	5000 nos
UP Electronics Corpn Ltd 10 Ashok Marg, Lucknow 226001 (Distt Meerut-Uttar Pradesh)	23 12.85 (NU)	Facsimile equipment	2000 nos
Murphy India Ltd Eastern Express Highway P.O. Box No 201, Naupada Thane 400602, Maharashtra (Any permissible location in Gujarat)	27 12.85 (NU)	Teletext decoders	5000 nos
Nettur Technical Training Foundation 23/24, II Phase, Peenya, Indl Area Bangalore 560058 (Distt Bangalore-Karnataka)	27 12 85 (NU)	Black-and-white TV receiver sets	5000 nos
Ramamohan Rao Mullapudi, 38 Vengal Rao Nagar Hyderabad (Distt Nalgonda-Andhra Pradesh)	27 12 85 (NU)	Laser printers	Rs 100 million
Manhori Electronics Najafgarh Road (Near Syndicate Bank) Bijwasan, New Delhi 110061 (Distt Gurgaon-Haryana)	27 12 85 (NU)	Facsimile transreceivers	2000 nos
The Orissa State Electronics Devt Corpn Ltd A-171 Sahidnagar Bhubaneswar, Orissa (Distt Puri-Orissa)	27 12 85 (NU)	1 Dot matrix printers 2 Floppy drives 3 Terminals 4. Keyboards	Rs 400 million
Eiko Computers (P) Ltd 301 Devatha Plaza 3rd Floor, Residency Road Bangalore 560025 (Distt Bangalore-Karnataka)	27 12 85 (NU)	Computer peripherals, matrix printers and daisy wheel printers	Rs 60 million
Wipro Information Technology Ltd 88 Mahatma Gandhi Road Bangalore 560001 (Any permissible area in Karnataka)	27.12.85 (NU)	Data communication systems comprising of switching devices, front-end processor modems/couplers and multiplexers	Rs 200 million
Peico Electronics & Electricals Ltd 7 Justice Chandra Madhab Road Calcutta 700020 (Any permissible area in Haryana)	27.12.85 (NU)	Acoustic transducers	2 million nos.

Name & Address of the Applicant and Location of the Undertaking (1)	Date & Type of Licence (2)	Article (3)	Quantity per Annum (4)
Crompton Greaves Ltd 1 Dr V B Gandhi Marg Bombay 400023 (Any permissible area in Maharashtra)	27 12 85 (NU)	Minicomputer/microprocessor programmable controllers	Rs 40 million
Tata Hydro Electric Power Supply Co Ltd Bombay House 24 Homi Modi Street Bombay 400023 (Distt Bangalore Karnataka)	27 12 85 (NA)	1 Switch mode power supplies (other than those reserved for the small-scale sector)	400 nos
		2 Modems	200 nos
		3 Power line monitors	200 nos
		4 Display test sets	50 nos
Electronic Research (P) Ltd 17th KM Old Madras Road Bangalore 560049 (Distt Bangalore Karnataka)	27 12 85 (NU)	Minicomputer/microprocessor based systems	Rs 200 million
Anuj Khurana 54/2 Punjabi Bagh New Delhi 110026 (Any location in Himachal Pradesh)	27 12 85 (NU)	1 Modems	3400 nos
		2 Mux	800 nos
Kerala State Electronics Devt Corpn Ltd., Keltron House Vellayambalam Trivandrum 695033 (Distt Trivandrum-Kerala)	27 12 85 (NU)	Electronic equipment for Defence 1 Echo sounders 2 Electromagnetic logs 3. Simulator I 4 Simulator II 5 Sono buoys 6 Radar interface units 7 Sonar locators 8 Militarised computers 9 VHF transreceivers	Rs 100 million
Wipro Information Technology Ltd S B. Towers, 88 M G Road Bangalore 560001 (Distt Mysore-Karnataka)	27 12 85 (NA)	Computer peripherals and serial printers	Rs 90 million in terms of value
Hindustan Vaccum Glass Ltd Sanshriti Bhavan Jhandewalan, New Delhi 110055 (Distt Solan-Himachal Pradesh)	27 12 85 (NA)	Floppy diskettes	3 million pcs
Himachal Pradesh State Electronics Devt Corpn Ltd Saligaram Bhavan, Khalini, Shimla (Backward area in Himachal Pradesh)	27 12.85 (NU)	Cordless telephones	Rs 30 million
Starch & Allied Industries 308 Narsee Natha Street Bombay 400009 (Distt Gandhi Nagar-Gujarat)	27 12 85	1 Ultrasound equipment	
		(a) Ultrasound lines scanners (portable mobile)	150 nos 150 nos
		(b) Foetal monitors	300 nos
		(c) Ultrasonic nebulisers	75 nos
		(d) Ultrasonic therapy units	50 nos
		2 Surgical diathermy group	
		(a) Solidstate surgical diathermy	200 nos.
		(b) Opthalium diathermy	25 nos
		(c) Shortwave diathermy	100 nos.
		3 Intensive care equipment	
		(a) Ventilators	100 nos
		(b) Polygraphs	25 nos
		4 General diagonistic and therapeutic equipment	
		(a) Stimulators	100 nos
		(b) Electronic stethoscopes	1000 nos
		(c) Electronic digital BP instruments	1000 nos
		(d) Electronic digital thermometers	1000 nos
		(e) Electronic pulse monitors	1000 nos.
Vineet Chandra 82/2 (33), Chandni Chowk Delhi 110006 (Any 'A' category distt in Uttar Pradesh)	27 12 85 (NU)	1 Electronic data processing ribbons for computer printers and electrical typewriters	4 million nos.
		2 Carbonless paper and other papers	400 tonnes
		3 Coated carbon paper	500 tonnes
Kirloskar Electric Company Ltd Industrial Suburb, Rajajinagar Bangalore 560010 (Distt Mysore-Karnataka)	29 12 85 (NA)	Industrial robots	200 nos
Karnail Singh Kler P O Box No 20738, Manama Baharain (Distt Ropar-Punjab)	30.12.85 (NU)	Colour and monochrome CRT/display monitors/terminals	Rs 80 million
Faxcom Systems C-99 Lajpat Nagar-II New Delhi 110024 (Any backward distt in Himachal Pradesh)	31 12 85 (NU)	Facsimile equipment	2000 nos.
Electro Scan India Ltd No 11 Ukkiyam, Terappakkam Madras 600096 (Any no-industry block or taluk in Tamil Nadu)	31 12 85 (NU)	Electronic components for CTV receivers	(in nos)
		1 Diode split line output transformers (type 482)	800,000
		2 Aluminium switch mode transformers (type-150)	800,000
		3 Chassis components (linearity coil type-517)	800,000
		4 Chassis components (amplitude coil type-543)	800,000
		5. Chassis components (driver transformer type-557)	800,000
		6 Chassis components (East West coil type-557)	800,000
		7. Chassis components (bridge coil type-557)	800,000
Electronics Corpn of Tamil Nadu Ltd 735 Anna Salai, Madras 600002 (Distt Chingelput-Tamil Nadu)	31 12 85 (NU)	Field telephones	5000 nos
CEAR India Multitronics (Pvt) Ltd J-41 South Extension Part-I New Delhi 110049 (Distt Gurgaon-Haryana)	31.12 85 (NA)	1 Pushbutton diallers	20,000 nos.
		2 Pay phones	30,000 nos.
Tata Burrough Ltd 207 Competent House F/14 Middle Circle Connaught Place New Delhi 110001 (Goa-Goa Daman & Diu)	27 1 86 (NA)	Mini/microprocessor based systems	Rs 200 million
Micro Ceramics Pvt Ltd A-8 Cooperative Indl Estate Hyderabad 500037 (Ranga Reddy-Andhra Pradesh)	29.1.86 (NA)	Hard ferrites	300 tonnes
Chandrasekar Rao A1-45 Mayapuri Apartments Begumpet, Hyderabad 500016 (Ranga Reddy-Andhra Pradesh)	29 1 86 (NU)	Switching mode power supply systems	20,800 nos.
The Sandur Manganese & Iron Ores Ltd "Lohadri Bhavan", Bellary District Yeshvantnagar, Karnataka (Distt Bangalore-Karnataka)	29.1 86 (NU)	Copper-clad laminates for printed circuit boards	400 tonnes
Consumer Electronics (Punjab) Ltd C/o Punjab State Electronics Devt and Prodn Corpn Ltd Sector-17B, Chandigarh (Ropar Punjab)	29 1.86 (NU)	Colour television sets	50,000 nos.
Mrs S Marwah E-5 Geetanjali Enclave New Delhi 110017 (Ghaziabad-Uttar Pradesh)	29.1 86 (NU)	Colour television receiver sets	50,000 nos
Punjab State Electronics Devt and Production Corpn Ltd Bank of India Bldg. 2nd Floor Sector 17B, Chandigarh (Ropar-Punjab)	29.1.86 (NU)	Cordless telephone sets	Rs 30 million
Tata Burroughs Ltd Bombay House, Homi Modi Street Bombay 400023 (Goa-Goa Daman & Diu)	31.1.86 (NU)	Winchester disc drives	Rs 140 million

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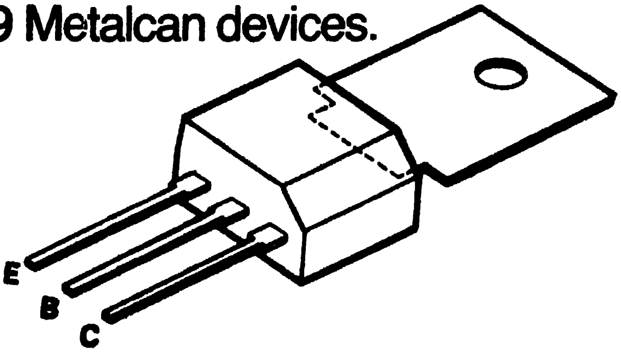

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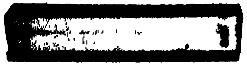

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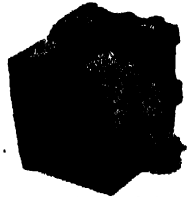

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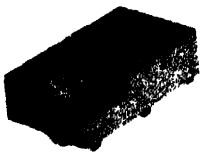

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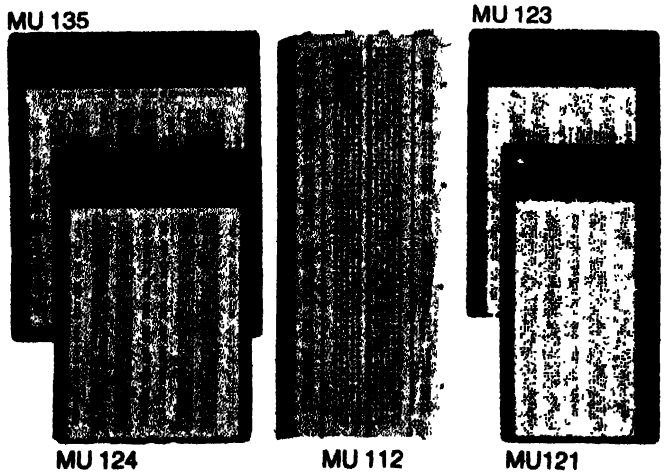

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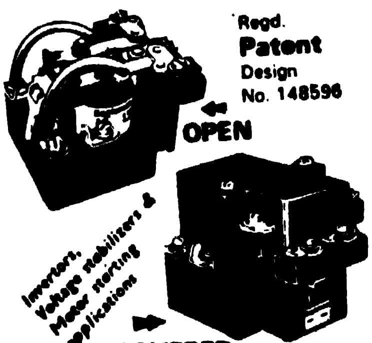
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Model No.		Min	Min	Max
BPE-21	BPE-31	1	0.5	2
BPE-22	BPE-32	3	2	6
BPE-23	BPE-33	5	6	20
BPE-24	BPE-34	10	25	80

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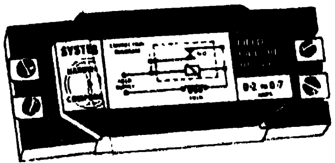

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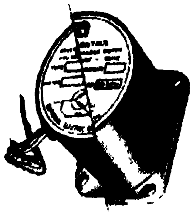

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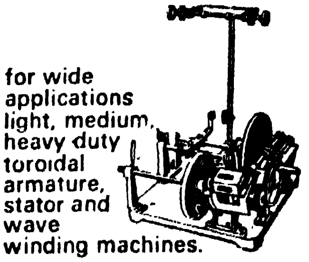

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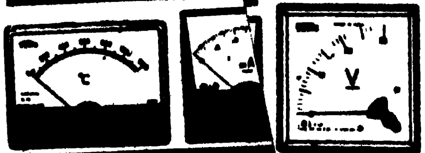

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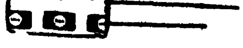

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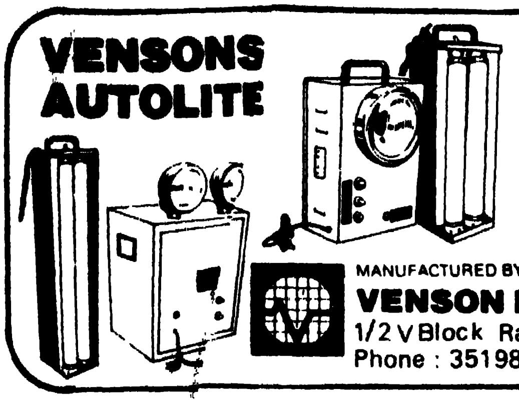

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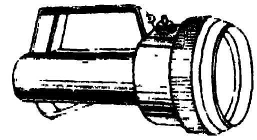

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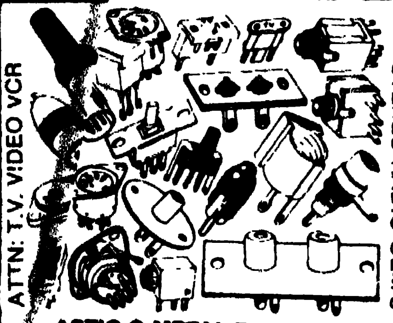

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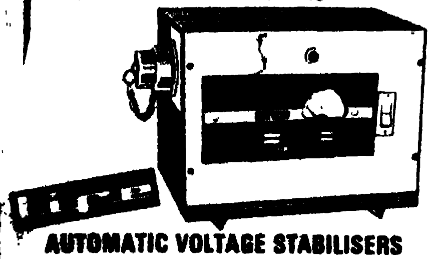

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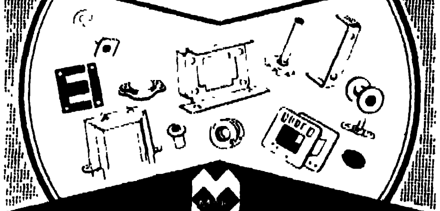

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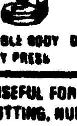

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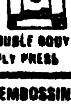

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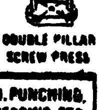

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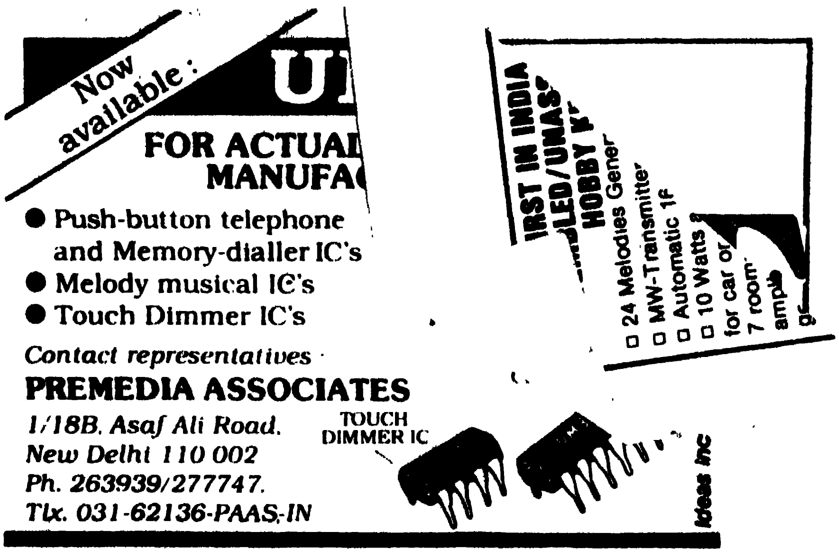

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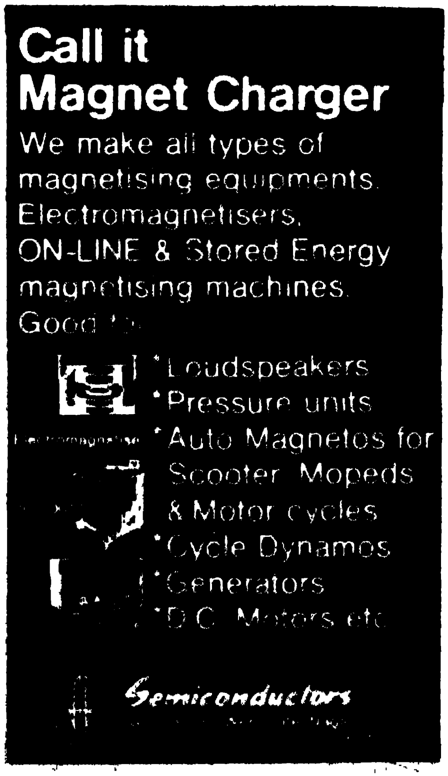

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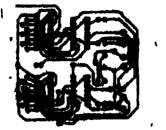

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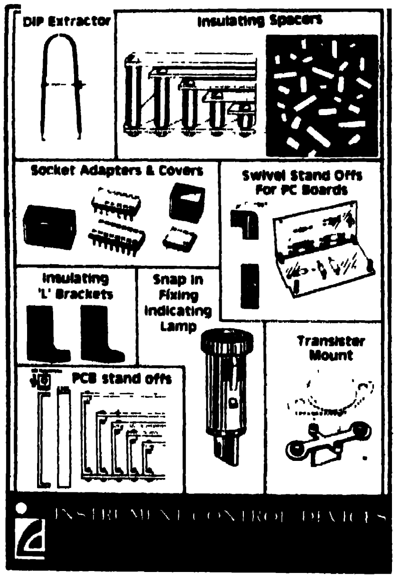

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ASE Ltd (Systronics)	20
Afco Industrial & Chemical	83
Alfa Products	30
Allied Publishers	66
Aradhna Electronics	82
Arun Electronics	76
Asia Electric	53
Associated Electrical Agencies	7
B.P B. Publications	10
B.R Enterprises	56
Balaji Engineering	8
Brisk Electro Sales	20
CTR Manufacturing	24
Consultancy Bureau	66
Dominion Radios	56, 94
Elco Sales	4
Electronic Instruments & Controls	56
Geeta Monitors	82
Hindustan Brown Boveri	75
Hindustan Conductors	101
Hyderabad Connectronics	25
ITT, West Germany	IV Cover
Inde Associates	9, 12
Integral Systems	30
Integrated Electronics	4
J.J. Electronics	102
Jaycee Commercial Corporation	6
Karnataka State Electronics	43
Klas Engineering	86
Kombinat, West Germany	74
Kusum Sales	88
Kwality Electricals	30
Labgear India	94
Leader, Japan	31
Leader Electronics, Delhi	94
Ledtron Electronics	23
Lunar Caustic	4
Meco Instruments	67
Mekasonic India	88
Motwane Manufacturing	48
N.G. Electronics	68
Nippon Denshi, Japan	76
Novoflex Cable	5
Pasadena Technology	54, 55
Poonam Industrial Research	3
Powerpacks	II Cover
President Marketing & Consultancy	37
Professional Electronics, Delhi	102
RC Information Technology, Bombay	67, 73
Rajasthan Electronics	76
Rohini Electronics	88
Saini Electronics	56
Sato India (Khanna Industries)	29
Sen & Pandit	47
Seqronics India	53
Series Audio Systems	III Cover
Shiltron Electronics	44
Shiv Shakti Electronics	81
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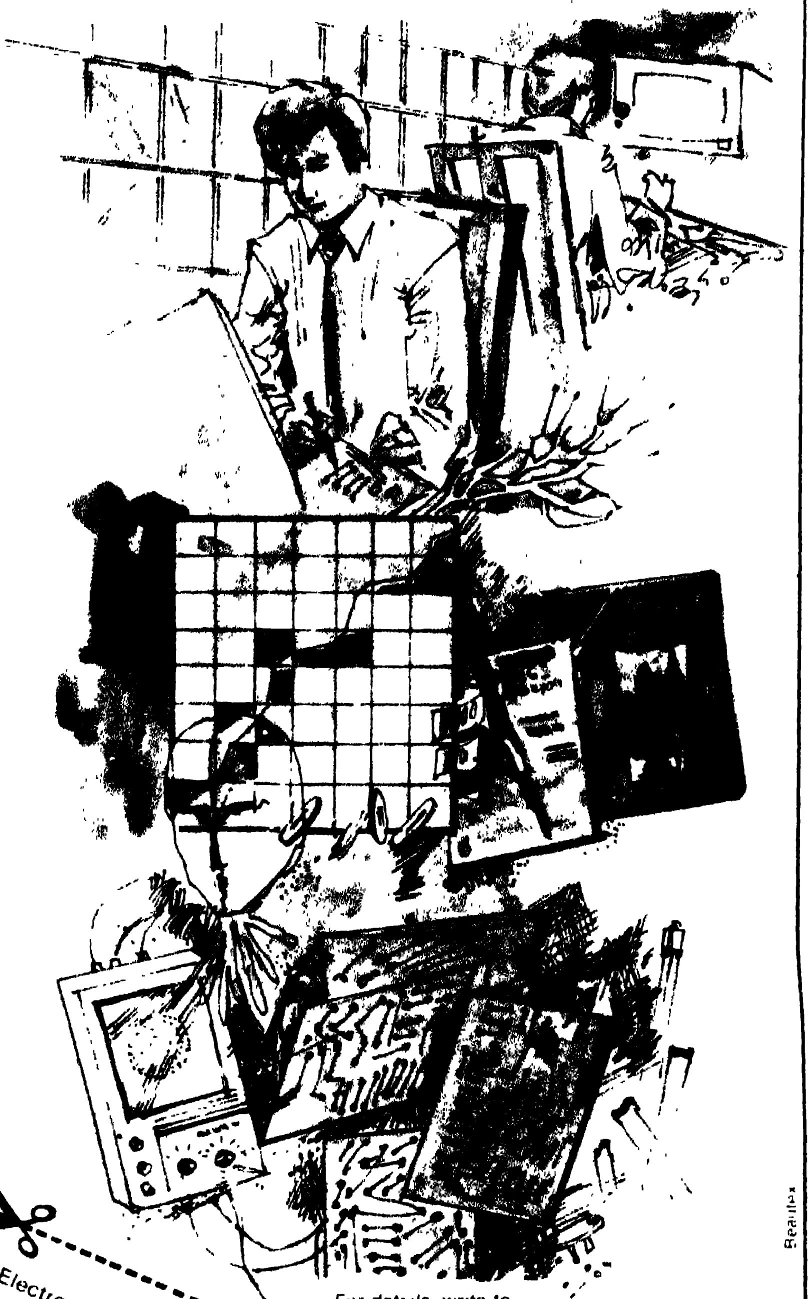

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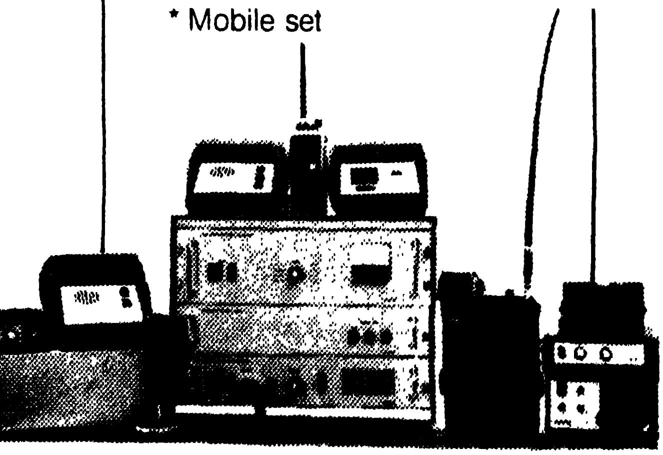

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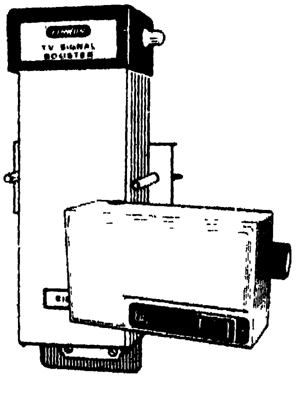

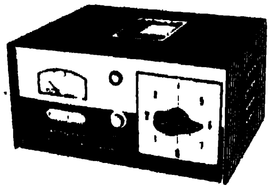

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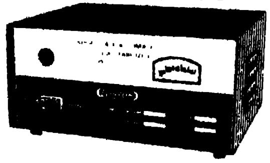

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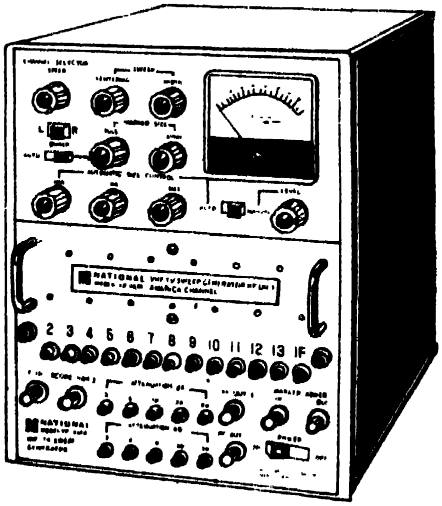

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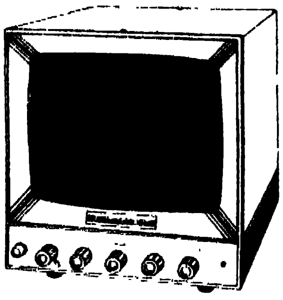

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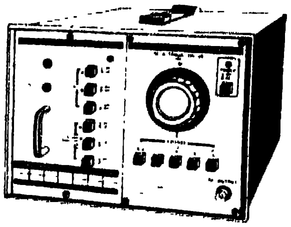

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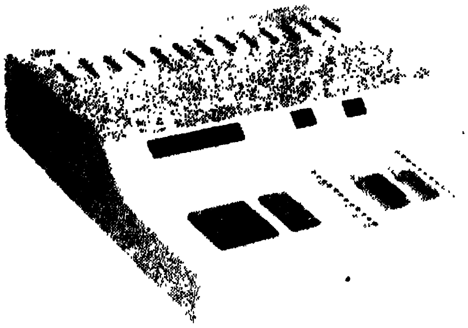

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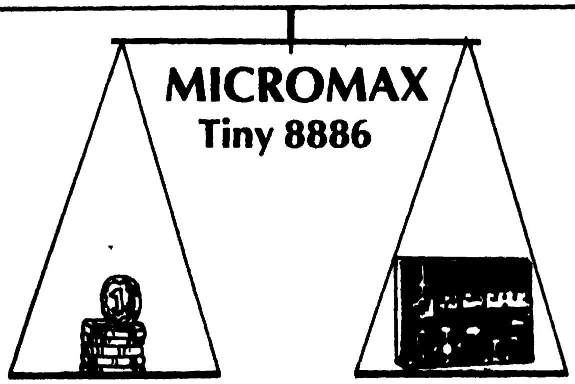

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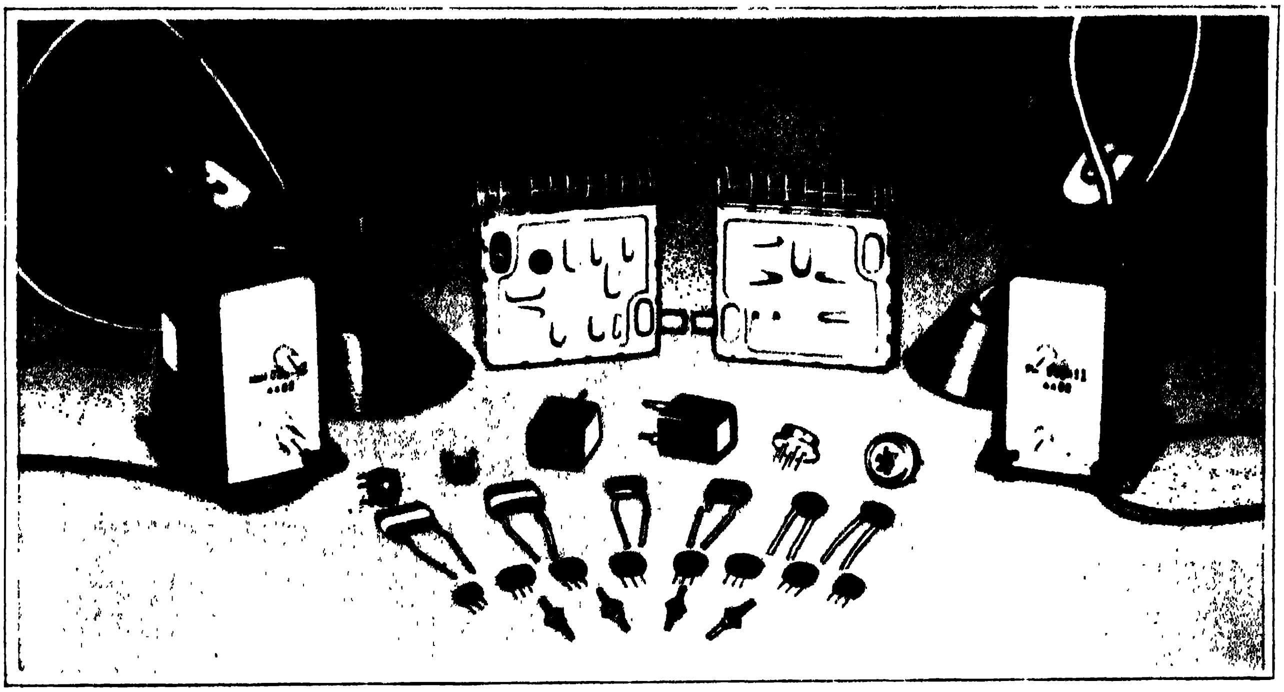

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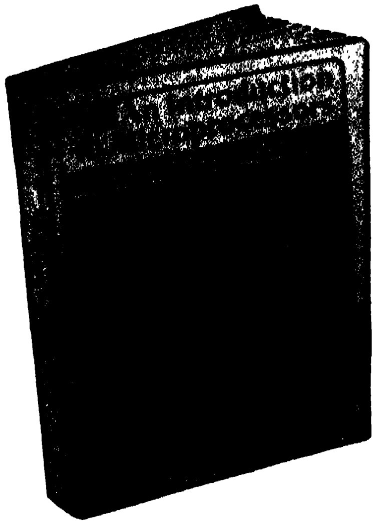

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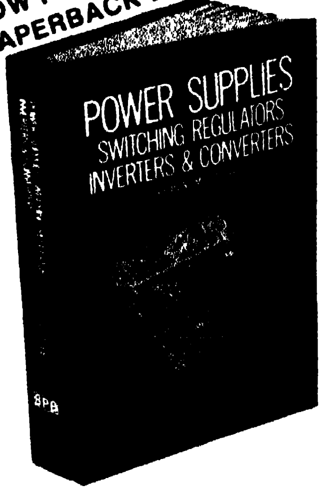

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Here, one easy-to-use volume is the most complete and up-to-date information available on switching regulators and power supplies Written and compiled by an author who is one of the most knowledgeable and respected authorities in the field, this is an essential tool for radio amateurs, electronics experiments, and computer hobbyists. . . as well as for electronics technicians and engineers.

Nowhere else can you find such a wide range of related technical data and practical applications of electronic equipment operating power. Whether you are building a homebrew radio transmitter, adding hardware capabilities to your computer, or are involved in state-of-the-art electronic design, you can count on finding exactly the advice and information you need. Plus, you will get hands-on-experience working in inverter, converter, and power supply circuitry with the wealth of circuit diagrams (many with parts lists) included here

With such a large portion of today's electronic equipment deriving their operating power from regulated supplies using inverters and converters—TV sets, radio transmitters, computers, electronic ovens, and more—you owe it to yourself to stay in step with all the latest develcpments. This exceptional guide-book gives you both technical data and practical applications in one power-packed volume.

CONTENTS

CHAPTERS Introduction. Inverters and Converters. An Overview. Theory Inverter and Converter Design. Transistor Inverter and Converter Applications. Thyristor Inverter and Converter Applications. Switching-Type Power Supplies. An Overview. Theory. Switching-Type Power Supplies. Noise Considerations. Switching AC Voltages. Switching DC Voltages Passive Switching Components. Semiconductor Switching Components. Voltage References and Comparators. Switching Regulator Design. Rectifier Circuit Design. Switching-Type Power Supply Applications. Appendix A Greek Symbols. Appendix B oltage or Current Ratios vs. Power Ratio and Decibels. Index.

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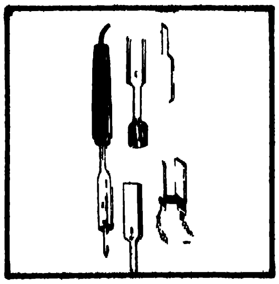
Amateur Radio Regulations

23 Amateur radio is becoming increasingly popular as a hobby in India yet few have complete knowledge about the government rules and regulations in this regard This article familiarises prospective hams with such policies and advises them how to import their hamming equipment

—Ashok Baijal, VU2AEY



A Zero-Cost, Infinite-Life Soldering Iron

46 Most electronic experimenters usually have a vast collection of burnt out soldering irons generally a result of the wide variations in the supply voltages in metropolitan cities This article describes a method for reconditioning damaged soldering irons so that hobbyists can experiment without fear of failure

P Narasimha Rao

Envelope Follower for Guitars and Organs

80 It is very difficult for amateur guitarists to obtain electronic gadgets since they are not made locally This project for an envelope follower produces an effect similar to wah-wah, except that it is automated Though designed for guitars it is equally suitable for organs

—D Gowdama Chandran

23 Amateur Radio Regulations *—Ashok Baijal, VU2AEY*

30 Photolithographic Techniques for LSI and VLSI. Part I *—J D Jain and A Srivastava*

35 High Voltage Power Supplies *—Nagesh Upadhyaya*

46 A Zero-Cost, Infinite-Life Soldering Iron for Electronics Experimenter *—P Narasimha Rao*

54 Signal Generator Program for Sinclair Spectrum Micro *—Ajay Chikersal*

61 An Introduction to Compilers *—Suresh K. Basandara*

67 Comparative Study of Computer Languages: Part XIII *—R. Ramaswamy*

72 Traffic Light Control Unit *—Ravi Kant Taxali*

80 Envelope Follower for Guitars and Organs *—D. Gowdama Chandran*

FEATURES

13 Letters
17 What's New
51 Computer Corner
59 Electroons
72, 80 Construction
87 Circuit Ideas
93 Product Profiles
99 Book Reviews
102 Company Profiles
106 Facts & Figures
111 Electronics Mart

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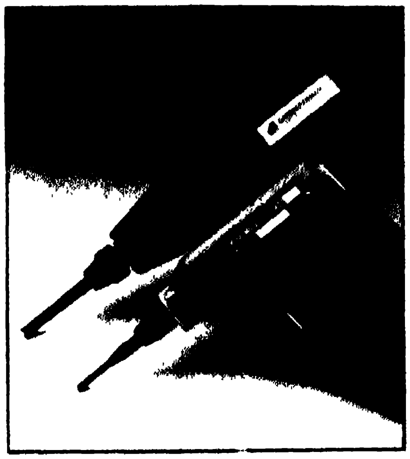
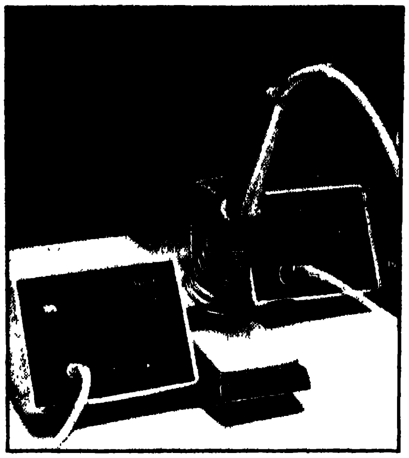
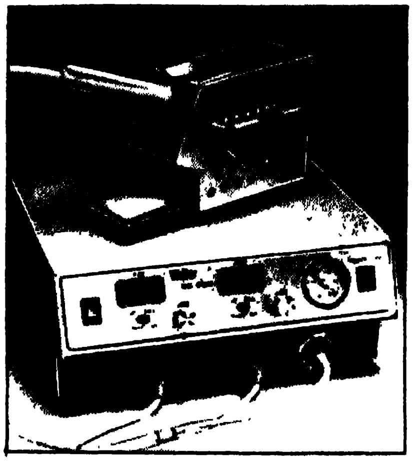


Wire wrap tools



Soldering stations



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KAVERI

Some Appreciations

I have just started taking interest in making electronic projects and gadgets. EFY has attracted my attention to the world of electronics. I have constructed some easy-to-make projects on my own.

Convey my thanks to Mr A. Subrahmanyam for the article on 'Troublesome Tubelight'. It is working very well.

SUNIL G. KRIPLANI
Bombay

□ The article on 'Quick 741 and IC 555 Tester' by Mr Anupam Saurabh which was published in the issue of March was found very interesting. I think you should publish more articles like this.

A. RAGHUNATHAN
Karaikudi

Available: PCB Factory and 2-way VHF/UHF Equipment

We wish to enquire whether you could, through your good office, locate suitable parties who are interested in: (1) VHF/UHF FM 2-way radiotelephone, repeater, telemetry etc, and (2) single-sided PCB factory.

MPE Electronics currently manufacture 2-way VHF/UHF radio and are looking for possible venture to sell these merchandise to the Indian market.

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J.C. LIM
General Manager
MPE Electronics Pte Ltd
45 Kallang Pudding Road
07-04 Alpha Building
Singapore 1334

Guide to BASIC

Continuing from my article in the January issue of EFY entitled 'A Simplified Guide to Computer Programming in BASIC' I've written a fairly simple program to illustrate some of the points that were raised. Your readers should quite easily (!!??) be able to follow the listing below which is for the BBC Micro/Acorn Electron.

The program is entitled 'Yes Mr President', and with certain changes works on the Apple, TRS-80, ZX-Spectrum, VIC and PET computers.

You are the President of a small island and your aim is to survive for 10 years in office. You are financed by gold mines, each worth £100, which are available to you to sell at any time to raise capital. You are responsible for feeding and educating your people. If you do not feed or educate them then they are likely to depose you!

Beware... every now-and-again your island is invaded by mosquitos which eat the main crop of your land and thus cause hardship and death to your people; you are required to help them with finance. If your people are

```
10 CLS
20LET G=INT(RND(1)*8+1)
30LET C=INT(RND(1)*200+100)
40LET P=INT(C/10+INT(RND(1)*[illegible]+1))
50LET M=0
60 LET Y=1
70 LET S=1
80 PRINT
90 LET M=P*100+INT(RND(1)*1500+1)+M
100PRINT"YOU HAVE ";G;" GOLD MINES EACH WORTH £100 AND "
110 PRINT"THERE ARE ";P;" PEOPLE ON YOUR ISLAND AND YOU HAVE £";M
120PRINT
130PRINT"HOW MANY GOLD MINES WOULD YOU LIKE TO SELL "
140 INPUT A
150 IF A>G THEN GOTO 1100
160LET G=G-A
170 LET M=M+(100*A)
180 PRINT"YOU NOW HAVE £";M;" BECAUSE YOU SOLD ";A;" MINES "
190 PRINT"LEAVING YOURSELF WITH ";G;" GOLD MINES"
200 PRINT
210 PRINT"HOW MUCH WOULD YOU LIKE TO SPEND ON FOOD "
220 PRINT"   THE MINIMUM AMOUNT RECOMMENDED [illegible] IS £100 EACH"
230 INPUT B
240 IF B>M THEN GOTO 1120
250LET M=M-B
260IF P*110>B AND B>100*P THEN LET S=S[illegible]
270IF B>111*P THEN LET S=S[illegible]
280IF B<99*P THEN LET S=S[illegible]
290 PRINT
300PRINT"HOW MUCH MONEY WOULD YOU LIKE TO SPEND ON EDUCATION "
310 PRINT" MINIMUM RECOMENDED IS £10 PER PERSON"
320INPUT D
330IF D<M THEN GOTO 440
340IF D>M AND G>0 THEN PRINT"YOU DO NOT HAVE ENOUGH MONEY"
350 PRINT"   WOULD YOU LIKE TO SELL YOUR GOLD MINES "
360INPUT I$
370 IF I$="N" THEN GOTO 300
380 PRINT"HOW MANY WOULD YOU LIKE TO SELL "
390 INPUT E
400 IF E>G THEN GOTO 380
410LET M=M+E*100
420LET G=G-E
430GOTO 300
440LET M=M-D
450IF D<5*P THEN LET S=S[illegible]
460IF D>6*P AND D<9.9*P THEN LET S=S[illegible]
470IF D>10*P THEN LET S=S[illegible]
480 PRINT
490PRINT"YOU HAVE ";G;" GOLD MINES AND THERE ARE ";P;" PEOPLE"
500 PRINT"ON YOUR ISLAND AND YOU HAVE £";M
510 PRINT
520PRINT"IT IS NOW THE HARVEST SEASON AND YOU HAVE ";C;" ACRES OF CORN"
530IF (RND*10+1)>2.5 THEN GOTO 550
540 GOTO 770
550LET X=(RND(1)*0.7+0.[illegible])
560 LET C=INT(X*C)
570 LET N=INT(P*(1-X))
580 PRINT"MOSQUITOS HAVE EATEN A LARGE AMOUNT OF CROP."
590 PRINT"YOU NOW HAVE ONLY ";C;" ACRES"
600 PRINT"ONE ACRE WILL USUALLY FEED 10 PEOPLE" ;
610 PRINT"- BUT NOW ";N;" WILL DIE."
620 PRINT"YOU CAN HELP THEM BY GIVING £20 MORE EACH TO THOSE THAT WILL DIE."
630 PRINT"DO YOU WISH TO HELP"
640INPUT A$
650IF A$="Y" THEN GOTO 690
660 LET S=S-0.2
670 LET P=P-N
680 GOTO 770
690PRINT"HOW MUCH [illegible] DO YOU WANT TO ALLOCATE IN MULTIPLES OF £20 "
700 INPUT F
710IF F>M THEN GOTO 690
720LET M=M-F
730LET L=F/20
740PRINT"YOU HAVE SAVED ";L;" PEOPLE"
750LET S=S+0.2
760LET P=P-N+L
770PRINT"THERE ARE ";P;" PEOPLE ON THE ISLANDS"
780 PRINT"AND YOU HAVE  ";M" AND ";G;" GOLD MINES"
```

```
Changes for different computers:

If you have an Apple then change line 10 to Home

If you have a VIC or PET then change line 10 to PRINT CHR$(147)

For lines 20 30 40 90 530 and 550,if you have a TRS-80 then chang
RND(1) to RND(0)

For lines 20 30 40 90 530 and 550,if you have a ZX-Spectrum then
change RND(1) to RND
```

satisfied with your performance then each year you will be rewarded with £1500 with which you can buy gold mines for a mere £25 and then resell them for £100. How's that for solving the world's problems!

See if you can survive 10 years in office. Try to expand the program to accommodate more random and unforeseen events (like the mosquitos). Since this program is designed to work on a number of computers, the PRINT statements may be too long for some of them. You can shorten them to suit your machine. Good Luck!

P. SHARMA
Middlesex, UK

SWL Using Domestic Receiver

It is really a great experience to be able to tune to the ham bands with a domestic receiver. I copied a lot of SSB (single side-band) amateur stations during the past few days using my National Panasonic 3-band domestic receiver (with cassette recorder) by providing the necessary injection voltage from the local oscillator of a 2-band pocket receiver set (Paman-batsman). I just tune this receiver to heterodyne with the ham band frequency and successfully use it as a beat frequency oscillator (BFO).

Coupling to the detector stage of the main ceiver is done only by keeping it near the iver. The BFO unit works very efficiently on the strong SSB signals but the weak SSB signals are somewhat suppressed. For readers' information, I am giving some details about what I have monitored during the past few days. I hope the hams who have been logging the activities will find my information correct!

The first OM I copied on February 7 at about 2339 IST was 'Bebu' from the QTH Belgaum with a call sign VU2PNU. I heard him with a QSA report of 5 and 7 here when he was calling a CQ. He was using a ICOM IC 751 shack with a simple dipole antenna. He was responded by VU2BSB from New Delhi whose handle was 'Balwant'. VU2PNU talked to VU2BSB and 'Raj' from Bangalore and the signal reports given by him to both of them respectively were 53 and 59.

At about 0002 IST, VU2PNU asked VU2KOC to go ahead. VU2KOC welcomed VU2PNU, VU2BSB and VU2RSD at the same time from the QTH Belgaum (same as Bebu) and told Balwant that it was already morning, so he wished him a very good morning and told him that he was coming very fantastic. VU2KOC gave the signal report as 57 to 58 to VU2BSB and wondered how Bebu was not copying VU2BSB as him. So he thought the reports to be critical for VU2BSB. VU2KOC introduced himself to VU2BSB as Omprakash. At about 0008 IST, VU2PNU explained the fact why both of them (VU2PNU and VU2KOC) from the same QTH received VU2BSB from New Delhi with a different signal report. According to him, both their antennae were simple dipoles, but his antenna direction was East-West while the antenna direction of VU2KOC was South-North; so VU2KOC was copying VU2BSB fantastic!

On February 8, I monitored the QSO between VU2HSM and UB4CWW at about 2049 IST until 2052 IST. VU2HSM was coming very loud and clear from Alleppey, South India near the Arabian Sea (as he told the Russian ham), and his name was Moni (handle) while the handle of the Russian station was 'Yuri'.

On February 9 at about 2252 IST, I copied the QSO between VU2KYX and 3B8FP. Handle of 3B8FP I heard was 'Rasid' (he perhaps came from Mauritius Islands!). VU2KYX was talking to VU2GXX and 3B8FP at the same time and was sorry to keep Rasid waiting as he was transmitting the second half of his message.

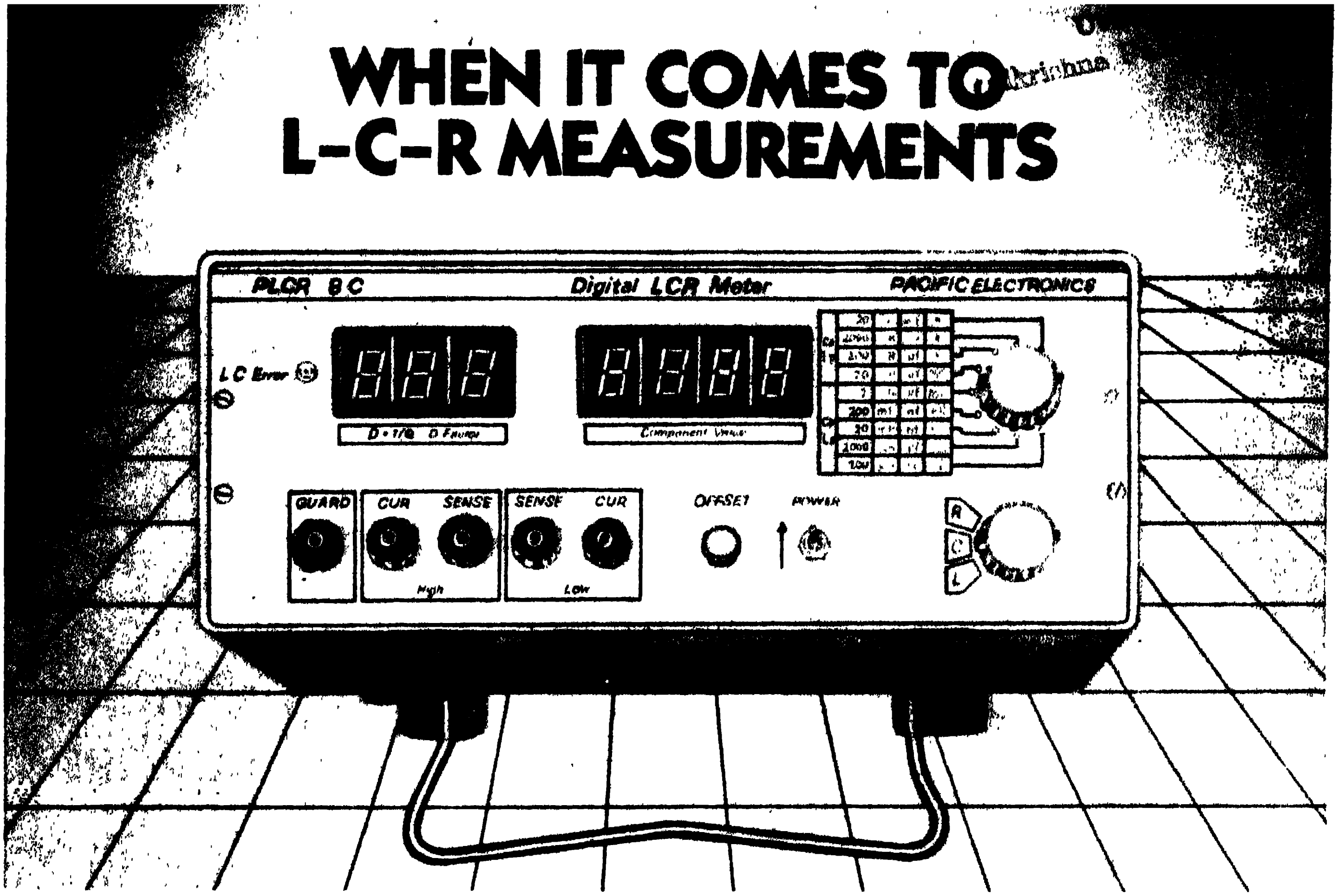
Let me mention that I copied all those amateur stations in the 20-metre ham band and yet on February 11, it was my good luck that I copied a Dutch amateur radio operator—one Mr Robbert—who was travelling on a cargo ship in the Indian Ocean. There was a nice QSO going on between Robbert and VU2KYX. I couldn't copy VU2KYX (whom I copied on Feb. 9) but Robbert was coming to me very well. I heard him at 1718 UTC (2248 IST). His QTH was about 700 miles west from Bombay and the exact position he gave to VU2KYX after he looked at a display in the radio room was 17 42 North and 64.08 East at about 1723 UTC. Robbert was bound for Iran. I could not copy Robbert's call sign but it was somewhat like PA3DA or PA3DKL followed by the words 'Maritime Mobile'. (I would be very glad if somebody give me his exact 'call-sign'!) Robbert talked to VU2KYX on different subjects and I really enjoyed him. He was a very jolly person. He talked about IBM and Apple computers, about his native country—the Netherlands. He told VU2KYX that he lives in the centre of the Netherlands, in a place called 'Culemborg'.

At about 1840 UTC, Robbert was called by VU2YU and the QSO lasted only for five minutes. Robbert told VU2YU that he met five to six hams from Bangalore and that he copied VU2YU with a report of 59 and with good modulation. He told VU2KYX that they had a satellite communication system in their cargo ship which was out of order since January 14. Robbert ceased his transmission at about 1845 UTC.

On February 13 at about 0230 UTC, I monitored the QSO between AP2MQ (handle: Mansur, QTH: Lahore) and JA5AUC. AP2MQ was also talking to JA3OCD. VS6HF.

I have been doing DXing in the last four or five months on the broadcast bands only. I came to the exciting world of ham bands with the same domestic receiver with a 6-metre long omnidirectional simple vertical antenna. This is a great achievement for me; and the credit goes to 'EFY' solely!

SANDEEP BARUAH
Suwonee Path, Lachit Nagar,
Guwahati 781007 (Assam)



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IN INDIA....

Electronic items de-reserved

The government has announced the dereservation of 14 items from the small-scale sector. These include four electronic items, viz, TV deflection components, electronic cigarette lighters, electronic flashguns and hearing aids.

Besides, in the case of 18 items, including TV tuners, the nomenclature has been changed keeping in view the changed conditions and requirements of the industry. The existing nomenclature 'TV tuners' has been changed to 'TV tuners excluding electronic tuners'. This would mean that while turret tuner continues to be in the small-scale, electronic tuner is out of it.

Elcina's awards for excellence

The Elcina awards for 1985 for excellence in research and development, import substitution, exports of electronic goods and indigenous development of capital goods were recently presented by Mr Abid Hussain, member, Planning Commission.

Central Electronics Engineering Research Institute (CEERI), Pilani, and Satwik Electric Controls Pvt Ltd, Nasik were adjudged joint winners of the award for research and development for their pioneering work in electronic instrumentation for sugar industry with R&D support provided by the Department of Electronics (DoE) under the Technology Development Council Programme.

The second prize for R&D went to Continental Device India Ltd (CDIL), New Delhi, for its significant contribution in R&D for improving the existing processes for semiconductor devices which have certain limitations for high reliability applications. These are: front metal process which overcomes the problems associated with aluminium, and tin plated metal-can transistors which overcome the problems associated with gold-plated parts.

A special certificate of merit was awarded jointly to Bharat Heavy Electricals Ltd (BHEL), Bangalore, and the University of Pune (Physics Department) for their noteworthy R&D contribution to enhance the manufacturing yields of power semiconductor devices by perfecting the control of some of their dynamic characteristics using electron irradiation—a good example of successful cooperation between industry and an academic institution in a frontier area of technology.

The award for import substitution was given to Rao Insulating Co. Pvt Ltd, Bangalore, for its sophisticated PCB facility for use in the manufacture of colour TV receivers. Hindustan Enterprises, Allahabad, received a special certificate of merit for its efforts in import substitution by manufacturing different types of electromechanical components and connectors of a wide variety for different applications, which have been type-approved and field-tested.

Sujata Data Products Pvt Ltd, Secunderabad excelled in export of electronic goods showing a remarkable export performance by exporting 45 per cent of its total production in 1985 totalling Rs 24.4 million.

Morris Electronics Limited, Pune was chosen for excellence in the indigenous development of capital goods by indigenising two major equipment used in the manufacture of hard and soft ferrites, namely, a high volume rotary calciner and an air-fired sintering furnace, resulting in significant savings of foreign exchange. This has led to upgradation of local capabilities for the development of this industry.

Second ILT digital exchange commissioned

India's second Integrated Local-cum-Trunk (ILT) digital exchange was commissioned recently at Hebbagodi, a rural industrial area near Bangalore. This is the first exchange of its type to be connected to the communications network in Karnataka. The first exchange has been installed at Udayamperoor near Ernakulam in Kerala.

The 512-line exchange, which has been jointly developed by the Indian Telephone Industries (ITI) and the Telecommunications Research Centre of the Department of Telecommunications (DoT), will help the subscribers of Hebbagodi to get quick access to the telecommunication network of the city of Bangalore, which hitherto was not possible.

The ILT is specially designed to economically serve the low capacity rural exchanges and brings the subscribers to the national and STD network. Some other highlights of this exchange which are not available in other exchanges are: call alert, call waiting hotline, malicious call trace, group hunt, and facility of ring-back when free.

Large-scale manufacture of this equipment has been undertaken at ITI's Palghat unit and a number of such exchanges will be in operation in the country's rural network in the near future.

I&B Ministry to monitor TV/AIR Projects

To ensure speedy implementation of the government policy to expand the radio and TV network, the Ministry of Information and Broadcasting will monitor the progress of the schemes every month.

This was decided at the fourth annual Conference of the Officers of the Civil Construction Wing (CCW) of AIR which met recently.

The conference was held to discuss the action plans of various civil and electrical works of AIR, Doordarshan and other media units of the Ministry of I&B, so as to achieve the targets assigned for the Seventh Five-year Plan.

Public data network commissioned

The first packet-switched experimental data network was recently commissioned by the communications minister, Mr Ram Niwas Mirdha. The versatile network offers a range of facilities to its subscribers, including transmission of videotex, facsimile and other telematic services. It will permit message transfer, interactive access to a distant computer and computer to computer communications.

Set up jointly by the Telecom Research Centre and TCIL, packet switching is a state-of-the-art technique for public data networks. It enables data communications on a real-time basis. In the initial trial stages, the service will be offered to a limited number of subscribers in Delhi, Bombay and Madras, free of charge, to enable the Department of Telecommunications to collect data on the type, pattern and volume of traffic, and also get feedback from the subscribers regarding any improvements or changes for greater utility of the service.

The network will provide a new service of electronic mail box. In this facility, a message sent across the network can be retrieved by the addressee at his convenience. Privacy will be ensured as the message would be available only after a code check

Access to the network would be possible in several different ways. One would be a direct one to any one node on the line. Phone subscribers will have access through the public-switched telephone network. The system can also be used through the telex machine.

The entire data communication software for this service has been developed by TCIL. This includes switching software, packet assembler and disassembler (PAD) software, electronic mail-box software, network management centre software which includes network configuration and control, network status monitoring, statistical and accounting data collection, accounting and traffic analysis and telex interference.

Based on the results of this experiment a bigger network is proposed within the next two years with eight nodes at Bombay, Delhi, Calcutta, Madras, Bangalore, Hyderabad, Pune and Ahmedabad. These nodes will link 20 cities all over the country, providing a widespread public data network which will also provide international access.

Telecom production touches a new high

The four telecommunication factories located at Bombay, Calcutta, Jabalpur and Bhilai achieved production worth Rs 334 million during the year 1984-85 as compared to Rs 324.2 million during the previous year. This is the highest production achieved so far. The factories achieved production aggregating Rs 242.9 million up to December 1985 against the annual target of Rs 394 million.

These factories manufacture a variety of equipments like manual trunk and local exchanges, PBX boards, coin box telephones, switchboard cords, DP boxes, CT boxes, line stores, telegraph equipment, microwave towers (steel lattice type) etc used as inputs for development and operation of telecommunication services.

The organisation has embarked upon an ambitious modernisation programme which includes (i) setting up of modern galvanising plants at Calcutta and Jabalpur; (ii) setting up of a modern integrated tube making plant at Jabalpur; (iii) manufacture of modern cable termination boxes at Calcutta; and (iv) setting up of a modern mechanised foundry at Kharagpur in West Bengal.

A contract was finalised with a West German firm Krone for the supply of plant and machinery and transfer of knowhow for the manufacture of modern cable termination boxes in the telecom factory at Calcutta. The staff has been trained in West Germany for the purpose.

India's ambitious space programme

India proposes to launch three specific purpose satellites a year during the next decade. This ambitious scheme is most likely to begin during August-September this year with the launching of the five-stage augmented satellite launch vehicle (ASLV) carrying a payload of 150 kg.

According to Dr Suresh Chandra Gupta, director, Vikram Sarabhai Space Centre (VSSC) at Thumba near Trivandrum, these satellites will be used exclusively for communications, remote sensing and back-ups. The Indian industry—both in the public and private sector—will be involved in this venture in order to make the country totally self-reliant.

The industry's opportunities lie in areas like mechanical fabrication, development of newer propellant formulations, polymers, special chemicals and electronics. The industry has already fabricated components for the first three stages of a launch vehicle while VSSC in-house research techniques are used for the final two stages.

According to Indian Space Research Organiation's (ISRO) plans, two ASLVs and two polar satellite launch vehicles (PSLVs) should be in orbit by the turn of the present decade. Instead of the present optical and near infra-red images, the future satellites will have microwave facilities.

India to make earth stations soon

India will manufacture for the first time low-cost earth stations with US collaboration. The US government has given the green signal to the Equitorial Inc., the only company in the world which has this technology, to go ahead with the collaboration arrangements. The Indian Telephone Industries (ITI), a public sector undertaking under the Department of Telecommunications, will be the Indian partner. An agreement is expected to be signed soon.

Under the agreement, the Equitorial Inc. has agreed to transfer knowhow for the manufacture of the earth stations. What is more, the two companies will manufacture these stations for exports.

The technology transfer is expected to be in a phased manner. Initially, 127 stations would be imported in CKD and assembled here to meet the immediate needs of the National Informatics Centre

Major Duty Reliefs to Electronics Industry

The Ministry of Finance recently announced a series of post-budget concessions to trade and industry which will cost the exchequer a loss of Rs 1000 million per year. A major share of the reliefs—to the extent of Rs 600 million—has gone to the electronics industry, where the customs duties have been drastically reduced.

The Ministry of Finance has evolved a customs tariff structure relating to raw materials, piece parts and components for the electronics industry in consultation with the Department of Electronics.

Raw materials and piece parts will now carry customs duty of 30 per cent and 45 per cent *ad valorem* respectively.

Capital goods for modernisation of the electronics industry will carry a concessional duty of 55 per cent *ad valorem*. Moulds, tools and dies for the electronics industry will also attract 55 per cent *ad valorem*.

The general rate of duty of customs on computers is being reduced from 200 per cent to 150 per cent *ad valorem*.

Components by way of spares of computer peripherals will now attract 75 per cent *ad valorem*.

On the excise side, the special scheme for radios and transistor sets of value not exceeding Rs 165 per set is being withdrawn. These goods have already been included in the general small-scale exemption scheme.

These concessions are a result of the discussions between the finance minister and representatives of trade and industry in open-house meetings held from time to time. These reliefs are expected to give a boost to the indigenous industry and also encourage competition.

(NIC). NIC proposes to instal about 400 such stations in the rural areas to connect them with the rest of the country and the computer network through satellite The cost of each station will be Rs 75,000.

It is for the first time that the US company has agreed to transfer the know-how for which it enjoys a monopoly throughout the world. It is the only company which specialises in the spread spectrum technology that enables linking of at least 2000 terminals on to the satellite through the earth station. These terminals can be placed on the satellite together Thus it offers a wider coverage of computer linkages.

Keltron's new chairman

Mr Thomas Kora took over as the chairman of the Kerala State Electronics Development Corporation (Keltron) on June 14, 1986. Besides his present assignment, Mr Kora is also the commissioner for Electronics Development in Kerala.

Mr Kora succeeds the first chairman of Keltron, Mr K.P.P. Nambiar, who resigned in February 1985 to take over as the chairman of the Indian Telephone Industries, Bangalore. For over one year, Keltron has been more or less headless although Mr P.G. Muralidharan, Industrial Development commissioner, was acting as the corporation's chairman.

CLIK executive committee

The Consortium of Electronics Industries (Karnataka) selected its new executive committee for the year 1986 at an annual general meeting held recently.

Mr B.J. Shreedhara was elected president in place of Mr Surendra P. Kamath who is the outgoing president. Mr H.S. Nagaraj was chosen as the vice-president. Other selected members were Mr B.T. Tukol (honorary general secretary), Mr S. Jayaram (joint secretary) and Mr R. Vardarajan (treasurer).

AREA plea to RBI

The All India Radio & Electronics Association recently had discussions with the sub-committee for Electronics appointed by the governor of the Reserve Bank of India regarding the availability of finance to the electronics trade and industry.

Since the volume of trade in electronics is expected to reach a target of Rs 108 billion, an effective and positive marketing back-up is a necessary corollary. The association has exhorted the RBI to extend financial assistance to electronics traders through various banks, and their requirements considered on a priority basis.

....AND ABROAD

USSR news through British technology

A British firm, Datasolve, is to be the first to distribute political and economic news from TASS, the Soviet news agency, by electronic means to anyone with a microcomputer Anyone in the world with a desk-top computer or word-processor connected to a telephone line will be able to gain access to TASS's 40,000-word English language newswire, which will be added daily to the database held on Datasolve's computers at Sunbury, west of London. Seventy stories and a 1000-word economic news bulletin will make up the daily TASS material. Earlier TASS stories will also be stored.

The TASS output will be part of World Reporter, the UK's largest full-text international news and current affairs service, offering over 350 million words at any one time and used in 30 countries

Developed jointly by Datasolve and the BBC, World Reporter uses sources that already include newspapers like *The Guardian* and *Financial Times* (Britain) and *Washington Post* (United States); Britain's *New Scientist* and *Economist* magazines; the 'Asahi' (Japan) and 'Associated Press' (United States) news services; and the BBC summary of world broadcasts and external services news.

A subscriber uses six simple keyboard commands to make an inquiry of World Reporter. In seconds the service searches out all items that may be relevant and indicates their headlines and length. If too many are found, further search words can be entered to refine the selection. All wanted items can be read on the computer screen or hard-copied on a linked printer for later study. Overseas subscribers can gain access to World Reporter through the worldwide IPSS data communications network, which is much cheaper than an international telephone call.

Taiwan electronics show

The 12th Taiwan International Electronics Show organised by the China External Trade Development Council will be held at Taipei between October 7-13 this year. The show will be held at the new exhibition hall of the Taipei World Trade Center who is also sponsoring the show.

More than 900 companies from Taiwan and abroad are expected to participate Countries taking part in the show include the USA, West Germany, Canada, Japan, Hong Kong, India and Singapore. The main exhibits at the show include computers and peripherals, industrial and domestic products, telecommunications equipment, parts and components.

Companies wishing to participate at the Taiwan Electronics Show may contact the China External Trade Development Council at the Taipei World Trade Center Exhibition Hall, 5 Hsinyi Road, Sec. 5, Taipei 10509, Taiwan, Republic of China before September 7.

Information system Interkama

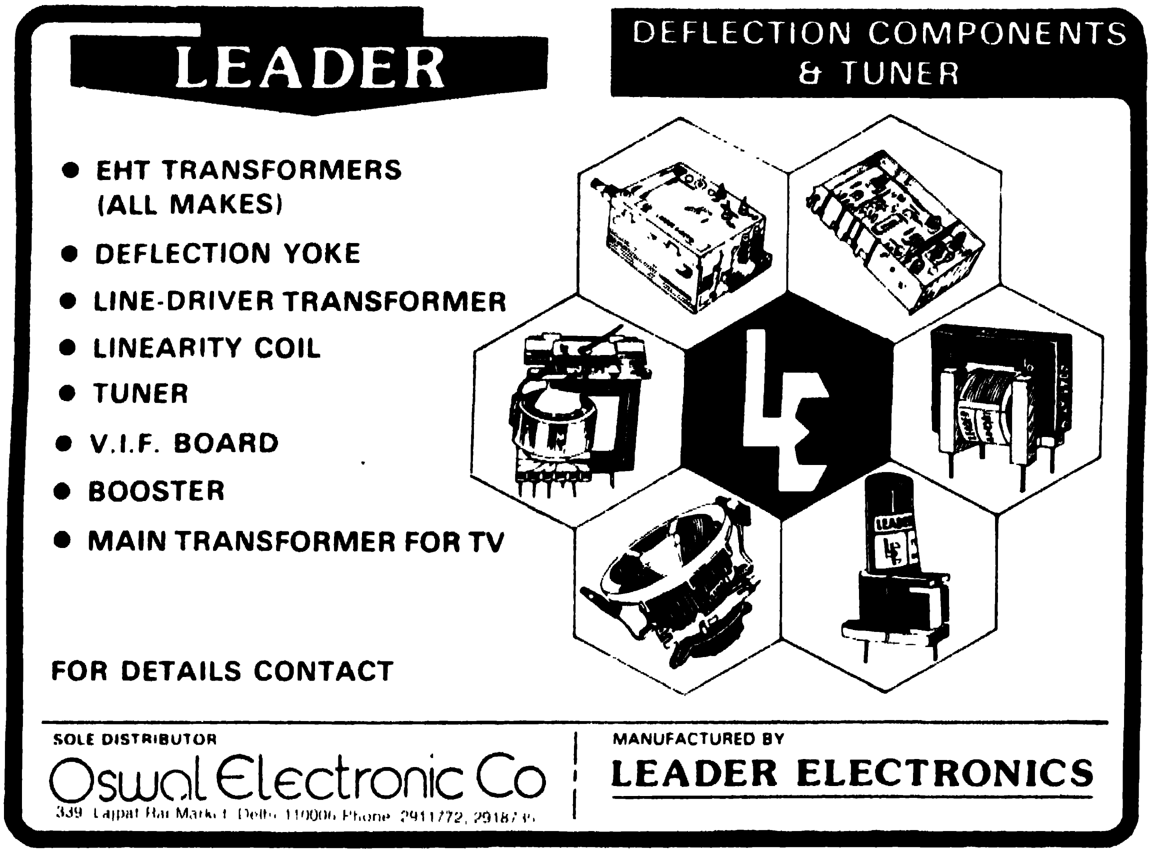
The Interkama is considered to be the world's first self-service fair information system providing information on a wide variety of subjects in a conversational mode.

First featured at the German Interkama fair in 1977, the system has been continuously updated. The latest system, the Interkama ISI, is based on Kabeltext, the leading information system in terms of efficiency and user friendliness.

For Interkama 86, the 10th International Congress with Exhibition for Instrumentation and Automation to be held at Dusseldorf between October 6-11, the number of terminals supplying information has been increased from 30 to 45 This increase is intended to reduce waiting time A swifter printout of "how to get there" instructions and a reduction in printing time will allow more frequent use of the system and faster dialogue.

The information facilities available from ISI have been extended by including an electronic meeting point. This allows visitors the possibility of leaving a note for persons they wish to talk to or have someone located and requested to turn up at a specific meeting point. This information can then be called up at all the ISI terminals.

The list of exhibits which can be interrogated in the ISI system has been extended to include synonyms. It now contains more than 3000 entries, providing visitors with a printout of a plan showing how to get to the product and containing details on the exhibitors of the product.



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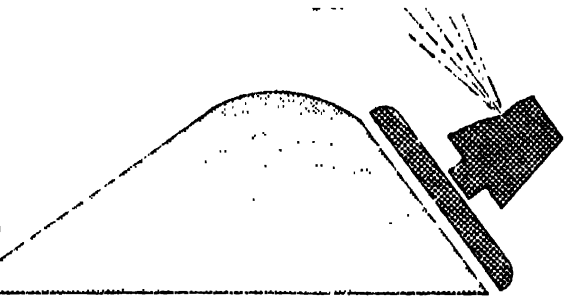

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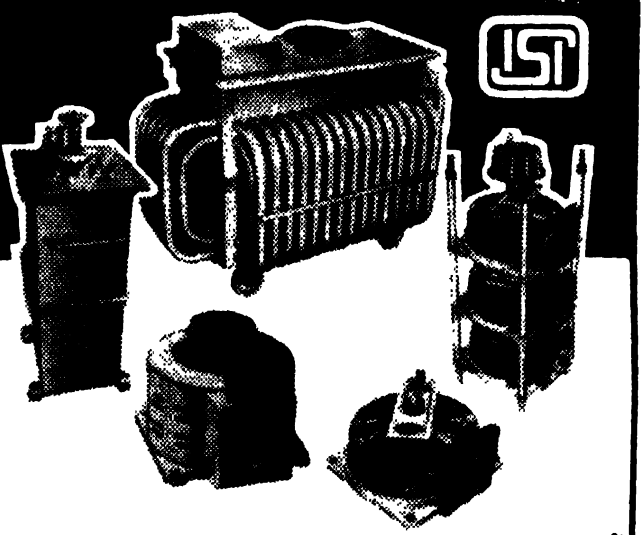

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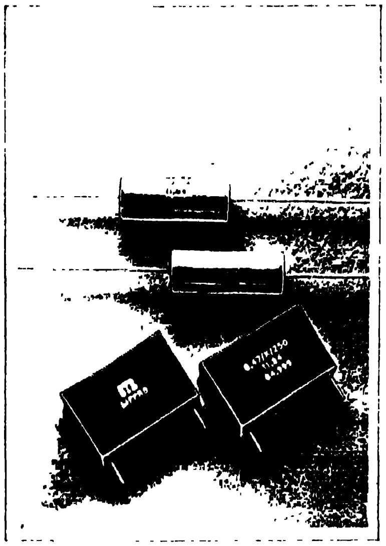

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Amateur Radio Regulations

Ashok Baijal VU2AEY

Amateur Radio is an exciting hobby. Hams or amateur radio operators are a group of people with common yet varying interests, who exchange ideas with 'on-the-air' contacts. You can be friends with a Japanese businessman, a US senator or a head of state without leaving the confines of your home.

Origin

Amateur radio was first started at the turn of this century. At that time there were no government regulations and 'amateur' experimenters started duplicating Marconi's inventions to communicate with each other 'on-the-air'. Soon the governments intervened and the amateurs were pushed to bands of 200 meters and below, then considered useless. However, it was discovered by hams that these frequencies permitted long distance communication. The beginning of World War I put an end to amateur radio operations and it was not until October 1, 1919 that the governments again permitted hams to transmit.

Amateurs have contributed a lot to the development of on-the-air communications. Their ideas have been absorbed by the industry with surprising results. The pre-war technical progress made by amateurs has provided the nucleus for development of modern military communication equipment, the single sideband (SSB) technique being one. Amateurs have even built their own communication satellites.

Indian regulations

The government of India has formulated 'the Indian Wireless Telegraphs (Amateur Service) Rules 1978' in terms of Sections 4 and 7 of the Indian Telegraphs Act 1885.

Amateur service has been defined as a service of (i) self training; (ii) intercommunication; and (iii) technical investigations in radio techniques carried out by persons (a) duly authorised, and (b) interested in radio techniques.

The service must be carried on (i) only with a personal aim, and (ii) without any pecuniary interest.

Types of messages

Messages of one station can be exchanged only with other duly authorised amateur stations. However, the amateurs are not allowed to communicate with amateur stations of countries whose administrations have notified to the International Telecommunication Union (ITU) of their objection to such radio communications.

Transmissions must be made in a plain language and limited to messages of a technical nature relating to tests, remarks of a personal character or a transaction in which both hams are directly concerned and for which by reason of their unimportance recourse to the public telecommunication service is not justified. However, the licensee is forbidden to transmit messages like the reproduction of broadcast programmes, tape recordings, transmissions of entertainment value or music. Also, false or misleading calls, news, advertisements, communications of business, statements on topics of political/industrial controversies, any matter which is indecent, obscene, seditious, offensive and likely to arouse racial, religious or communal animosity or messages for or on behalf of third parties are forbidden.

However, in case of failure of normal telecommunication facilities, amateurs are permitted to handle third party messages pertaining to natural calamities such as earthquakes, floods, cyclones and widespread fires. These messages should emanate from and addressed to a competent civil authority.

Licence

In order to establish, maintain and work an amateur wireless telegraph station, it is essential to hold a licence issued under Section 4 of the Indian Telegraphs Act 1885.

There are five categories of licences, namely:

1. Advanced Amateur Wireless Telegraph Station Licence.
2. Amateur Wireless Telegraph Station Licence Grade I.
3. Amateur Wireless Telegraph Station Licence Grade II.
4. Restricted Amateur Wireless Telegraph Station Licence.
5. Short-wave Listeners' Amateur Wireless Telegraph Station Licence.

Eligibility

A licence may be granted to a person who fulfils the following criteria:

1. He is a citizen of India.
2. He is not less than 12 years of age if he desires a Restricted Grade or Grade II licence, or has completed 14 years of age for Grade I licence, or 18 years of age for Advanced Grade Licence.
3. He should be a holder of a certificate or should qualify the examination specified below:
   - (i) A Radio Communication Operators' General Certificate; or
   - (ii) A first or second class Radio Telegraph Operators'

Box I

APPLICATION FROM AN INDIVIDUAL FOR A LICENCE TO ESTABLISH, MAINTAIN AND WORK AN AMATEUR WIRELESS TELEGRAPH STATION IN INDIA

[See Rules 6 and 8]

1 Name

(Last name) (First) (Middle)

2 Father's name and address

3 Address (Present)

4 Address (Permanent)

5 Date of birth' Place of birth Nationality' Occupation

6 (a) Category of licence applied for (b) Exact location of the Station

7 Do you hold Radiotelegraph Operator's Certificate? If yes, give particulars

Name of the certificate No. Date of issue

8. Particulars of Amateur Station Operator's Examination

Name Centre Month of Examination

9 Particulars of apparatus to be used.

Apparatus	Manufacturer's Name	Type No.	Frequency Range	R F Power Output
Transmitter				
Receiver				
Frequency measuring device				

10 If appeared in any of the Amateur Station Operator's Examination Yes, No

If yes, indicate the date of the examination

DECLARATION

I hereby, solemnly declare that the foregoing facts are true and correct and nothing is false therein and nothing material has been concealed therefrom I also agree that in case any information given by me hereinbefore is found false at a later date, the licence, if granted, will be cancelled

I further solemnly give an undertaking that I will not either directly or indirectly divulge to any person, except when lawfully authorised or directed to do so, the purport of any message which I may transmit or receive by means of any wireless apparatus operated by me or which may come to my knowledge in connection with the operation of said apparatus.

I have carefully read and understood the rules contained in the Indian Wireless Telegraphs (Amateur Service) Rules, 1978 and undertake to abide by them and observe the conditions of the licence. The licensed station shall not be made accessible to any unauthorised person at any time

Signature of witness.
Name (in block letters).
Address
Date

Signature of applicant:
Name (in block letters)
Date:
Place

Note—1 An attested copy of birth certificate or school leaving certificate must be accompanied along with the application.

2 Enclose a certificate in support of nationality in the prescribed proforma, indicated in Box III from one of the officers listed therein.

Certificate; or

(iii) The relevant Amateur Station Operators' Examination.

The amateur station operators' examination

The amateur station operators' examination is conducted by the Ministry of Communications at the following places:

1. Delhi Bombay, Calcutta and Madras—every month.
2. Ahmedabad, Hyderabad and Nagpur—January, March, June, August, October and December.
3. Ajmer, Bangalore, Darjeeling, Gorakhpur, Jullundar, Goa, Mangalore, Shillong, Ranchi, Srinagar and such other places where a monitoring station of the Monitoring Organisation of the Ministry of Communications is located—January, April, July and October.

An application on the prescribed format (Box I) has to be submitted to the examination centre not later than the 15th of the month preceding that in which it is desired to take the examination. The application form must be accompanied by a draft drawn in favour of the "Pay and Accounts Officer, (Secretariat) Ministry of Communications, New Delhi" payable at the State Bank of India, Main Branch, Parliament Street, New Delhi on the following scales:

(i) Advanced Amateur Station Operators' Examination	Rs 25.00
(ii) Amateur Station Operators' Grade I Examination	Rs 20.00
(iii) Amateur Station Operators' Grade II and Restricted Grade Examination	Rs 10.00

The examination consists of a written paper and a practical on morse sending and receiving. The written paper consists of two sections one on radio theory and practice and the second on national and international regulations applicable to the operation of an amateur station.

In case of Restricted Grade and Grade II examinations, the written paper is of one hour duration. The candidate must secure at least 40 per cent marks in each section and 50 per cent in aggregate for a pass. While candidates for Restricted Grade are exempted from morse sending and receiving; candidates for Grade II must be able to send and receive a test piece of plain language at a speed of five words per minute. For Grade I examination, the written test is of two hours' duration. Further, the candidate is required to receive a test piece of 300 characters including letters, figures and punctuations sent in morse at a speed of 12 words per minute. A similar passage has also to be sent at the same speed. For the Advanced Grade examination, the written paper is of three hours' duration.

The detailed syllabus for the Grade I and Grade II examinations is given in Box II.

Frequencies, emissions and power

Radio amateurs are allocated frequency bands, power and types of emission by the central government. The allocation is done keeping in view, among other things, the provisions of the ITU convention and the need for enforcement of better technical standards in respect of equipment and natural and international radio interference patterns. The present allocations are given in Box III.

Box II

Detailed Syllabus of Amateur Station Operators' Examination

SECTION I: Radio Theory and Practice

Elementary electricity and magnetism:

Elementary theory of electricity, conductors and insulators, units, ohms law, resistance in series and parallel, conductance, power and energy, permanent magnets and electromagnets and their use in radio work; self and mutual inductance; types of inductors used in receiving and transmitting circuits, capacitance; construction of various types of capacitors and their arrangements in series and/or parallel.

Elementary theory of alternating currents:

Sinusoidal alternating quantities—peak, instantaneous, RMS average values, phase; reactance, impedance series and parallel circuits containing resistance, inductance, capacitance; power factor, resonance in series and parallel circuits; coupled circuits; transformers for audio and radio frequencies.

Thermionic valves:

Construction of valves; thermionic emission, characteristic curves, diodes, triodes and multi electrode valves; use of valves as rectifiers, oscillators, amplifiers, detectors and frequency chargers, power packs, stabilisation and smoothing, elementary theory and construction of semiconductor devices—diodes and transistors.

Radio receivers:

Principles and operation of TRF and superhetrodyne receivers, CW reception; receiver characteristics—sensitivity, selectivity, fidelity; adjacent channel and image interference; AVC and squelch/circuits; signal to noise ratio.

Transmitter:

Principles and operation of low power transmitter; crystal oscillators, stability of oscillators.

Radio propagation:

Wave length, frequency, nature and propagation of radio waves; ground and skywaves; skip distance; fading.

Aerials:

Common types of transmitting and receiving aerials.

Frequency measurement:

Measurement of frequency and use of simple frequency meters.

SECTION II:—Regulations

(a) Knowledge of
  (i) The Indian Wireless Telegraph Rules 1973;
  (ii) The Indian Wireless Telegraph (Amateur Service) Rules 1978.

(b) Knowledge of International Radio Regulations as relating to the operation of amateur stations with particular emphasis on the following:

Item	*Provision of Radio Regulation*
Designation of Emission	104-110
Nomenclature of the frequency and wavelength	112
Frequency Allocations to Amateur Services	Article 5
Measures against interference	667-677
Interference and Tests	693-703
Identification of Stations	735-737, 743, 772-773
Distress and Urgency Transmissions	1389-1396, 1477-1478, 1481, 1483
Amateur Station	1560-1567
Phonetic alphabets and figure code	Appendix 16

(c) Standard frequency and time signals services in the world.

(d) The following 'Q' codes and abbreviations which shall have the same meaning as assigned to them in the convention: QRA, QRG, QRH, QRI, QRK, QRL, QRM, QRN, QRQ, QRS, QRT, QRU, QRV, QRW, QRX, QRZ, QSA, QSB, QSL, QSO, QSU, QSV, QSW, QSX, QSY, QSZ, QTC, QTH, QTR and QUM.

AA, AB, $\overline{\text{AR}}$, $\overline{\text{AS}}$, C, CFM, CL, CQ, DE, K, NIL, OK, R, TU, $\overline{\text{VA}}$, WA, WB.

Importing equipment

Every ham requires a communication receiver, a transmitter and a suitable antenna for operation. A communication receiver is similar to an ordinary broadcast receiver but has a high sensitivity and selectivity since it has to receive very weak signals on overcrowded frequency bands. The transmitter must have high frequency stability and negligible spurious radiation.

Till a few years back, the Indian ham had to build his own equipment as its import was not allowed. However, he was greatly assisted in his effort by the availability of large quantities of World War II surplus equipment in the junk market. But now these supplies have dried out.

The government of India in its effort to promote this hobby permitted the import of amateur equipment by including it under the open general licence (OGL). However, since these items were subject to heavy customs duty only a few hams were able to take full advantage.

At the request of the Amateur Radio Society of India, the central government vide notification no. 78/84 and 79/84 customs dated March 9, 1984 exempted wireless apparatus, accessories and components specified in the notification from the levy of customs duty subject to a CIF value of Rs 10,000 when imported by a licensed amateur radio operator. The facility was initially available up to March 31, 1985. The last date was subsequently changed to December 31, 1985, but since a number of amateurs were not able to avail this facility, the Ministry of Finance issued a further notification under which the CIF value has been enhanced to Rs 15,000 and last date for import extended to December 31, 1986. The list of wireless apparatus, accessories and components exempted from customs duty is reproduced in Box IV.

In order to avail the customs duty exemption, the importer must have:

1. A valid Amateur Wireless Telegraph Station Licence.
2. A certificate from an officer not lower in rank than an assistant wireless adviser to the government of India in the Ministry of Communications that the quantum of imports of the said wireless apparatus, accessories and components are within the CIF value limits specified in the conditions,

Box III
Frequency Bands, Emission and Power

Frequency Bands	*Category of Licence* *Advanced Grade*	 *Grade I*	 *Grade II*	 *Restricted Grade*
1820-1860 kHz 3500-3700 " 3890-3900 " 7000-7100 14000-14350 " 18068-18168 " 21000-21450 " 24890-24990 " 28000-29700 "	150 watts A1A, A2A, A3E, H3E, J3E, R3E, F1B, F2B, F3E, F3C, A3C, A3F	150 watts A1A, A2A, A3E, H3E, J3E, R3E, F1B, F2B, F3E, F3C, A3C, A3F	50 watts A1A,—A3E, H3E, J3E, R3E	NOT ALLOWED
144-146 MHz	50 watts —do—	—do—	10 watts A1A, A2A, A3E, H3E, J3E, R3E, F1B, F2A, F3E	10 watts — — A3E, H3E J3E R3E, — — F3E
434-438 "	—do—			
1260-1300 " 3300-3400 " 5725-5840 "	25 watts —do—	25 watts —do—	NOT ALLOWED	NOT ALLOWED

Explanation of symbols:

First symbol—Type of modulation of the main carrier
A — Double sideband
H — Single sideband, full carrier
R — Single sideband, reduced or variable carrier
J — Single sideband suppressed carrier
F — Frequency modulation

Second symbol—Nature of signal modulating the main carrier
1 — A single channel containing quantised or digital information without the use of a modulating sub-carrier.
2 — A single channel containing quantised or digital information with the use of a modulating sub-carrier.
3 — A single channel containing analogue information

Third symbol—Type of information to be transmitted
A — Telegraphy for aural reception
B — Telegraphy for autometer reception
C — Facsimile
E — Telephony
F — Television

and recommending the grant of exemption under the relevant notification

To obtain the above certificate the importer must apply to the WPC wing of the Ministry of Communications on the prescribed format along with a proforma invoice and technical catalogues from the supplier of the equipment and a draft of Rs 10 as application fee. The ministry on being satisfied shall grant the relevant certificate.

The importer can thereafter approach any scheduled bank for arranging the remittance of foreign exchange either by a draft or a letter of credit. An advance draft can only be issued for imports valued US $1000 or less, otherwise a letter of credit is the only alternative.

Foreign manufacturers

The major world suppliers of ham equipment are based in Japan. The market leaders are Trio-Kenwood, Icom and Yaesu-Musen.

Their addresses are:

1. Icom Incorporated,
   1-6-19 Kamikurazukuri,
   Hirano-ku, Osaka, Japan.
2. Yaesu Musen Co. Ltd,
   7-7, 1-Chome, Yaseu, Chuo-ku,
   Tokyo, Japan.

The above companies are represented in India by their local agents. To our knowledge their local agents are:

1. Basic Electronic Enterprises,
   A/3-4 New Empire Industrial Estate,
   Kondivita Road, J.B. Nagar,
   Bombay 400059.
2. Choice Agencies,

Box IV
List of Wireless Apparatus, Accessories and Components exempted from levy of Customs Duty

Wireless apparatus and accessories

1. HF transceiver (combination of transmitter and receiver) meant for amateur frequencies with accessories in assembled or kit form.
2. VHF transceiver (combination of transmitter and receiver) meant for amateur frequencies with accessories in assembled or kit form.
3. UHF transceiver (combination of transmitter and receiver) meant for amateur frequencies with accessories in assembled or kit form.
4. VHF-VHF or VHF-UHF repeater (combination of transmitter and receiver) meant for amateur frequencies with accessories in assembled or kit form.
5. Transceiver for amateur frequencies in assembled or kit form.
6. Grid dip oscillator.
7. Radio frequency interference filters.
8. Antenna with or without feeders, antenna rotators for amateur frequencies.
9. Balun transformers.
10. SWR bridges or reflectometers.
11. Digital frequency counters (up to 6000 MHz) with accessories.
12. Morse readers.
13. Noise bridges.

Components

1. Transistors, diodes, integrated circuits/chips.
2. Thermionic valves or vacuum tubes.
3. Toroidal cores.
4. Quartz crystals.
5. Variable condensers (air-dielectric type)
6. Precision capacitors (fixed type) of value between 1pF to 5000pF
7. Relays.
8. Spare NiCd cells or packs as required or used with items 2 or 3 above (in case of handheld transceivers).
9. Rotary switches.
10. Ferrite beads.
11. Slow-motion tuning mechanism with/without dials.

Note: The CIF value of the said components should not exceed Rs 1000.

Sunflower Flat,
11/VI Carter Road, Bandra,
Bombay 400050.

Types of equipment

The ham equipment can be broadly classified into equipment for HF and VHF use.

HF equipment is suitable for long distance communications whereas the VHF equipment is suitable for line of sight transmission. Full technical details of the equipments along with the latest price lists can be had from the manufacturers/local agents.

It is hoped that a large number of readers will take advantage of the concessions provided by the government and will come 'on-the-air' soon. □

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NOMADS

Photolithographic Techniques for LSI and VLSI

Part I

J.D. Jain and A. Srivastava

Recent progress in electronics has been mainly in semiconductor technology, particularly in the field of silicon technology. LSI (large scale integration) and VLSI (very large scale integration) has resulted from the efforts to increase the packing density of the components as well as the functions of the circuits on each chip.

In the field of process technology, much stress has been laid in the improvement of micron and submicron lithography and thinner films formation technology. In fact, lithographic and etching techniques are the keys to the VLSI -leading to increase in circuit complexity, its performance and improvement in wafer process yield.

Lithography is a very old technique developed initially by the graphic arts industry, now utilised extensively in the manufacture of printed circuit boards. It has recently been improved almost to the physical limits of perfection by the semiconductor electronic industry. As applied to semiconductor devices, e.g. ICs, it is common to indicate the very high resolution accomplished by the term 'microlithography'.

Lithography is that part of IC manufacturing process in which detail geometries of microscopic size are obtained. Lithography is used repeatedly during the fabrication of ICs to delineate the areas of IC components in which diffusion, ion implantation, etching and metalisation are to be allowed or prevented. It transfers the geometric pattern of the IC components to a wafer by a mask or by direct writing and permanently establishes the patterns on the wafer by means of etching.

The major characteristics of IC devices are component density, component speed, delay and minimum line width. The minimum line width is expected to reach 0.5 micron, and number of components per IC to 33 million by 1986. These expectations for future devices indicate that lithographic techniques and equipments such as for aligning and exposing must be capable of meeting the minimum line widths and overlay requirements in order to achieve the expected increase in the component density. Lithography shares the largest portion of the total IC manufacturing cost.

In this article, lithographic techniques such as optical, deep UV, X-ray, electron and ion beam have been explained. In the etching process, wet etching and dry process techniques have been covered. Dry process technique covers plasma, ion beam reactive, non-reactive and sputter etching aspects.

OPTICAL LITHOGRAPHY

Optical lithography refers to a means for patterning the resist using actinic radiation in the optical region of the electromagnetic spectrum. This visible spectrum lies between 3800 Å (violet) and 7800 Å (red) radiation for which $\lambda < 3.8$ is called ultraviolet, down to about $\lambda \sim 100$ Å below which they are called X-rays. Radiation of $\lambda > 7.8$ belongs

---

Mr J.D. Jain is assistant director of the A&A Division at the Central [illegible]ctronics Engineering Research Institute (CEERI) of the Council of [illegible]ntific and Industrial Research, Pilani, Rajasthan. His co-author, Mr A. [illegible]stava works at the CEERI Extension Centre, New Delhi.

to infrared. For $\lambda < 10$um or 10^{-3}cm, the radiations are said to be in the near infrared and for $\lambda < 10\mu$ are said to be far infrared.

A key aspect of fabrication of semiconductor ICs/ LSI/ VLSI is the precise delineation of patterns in various materials such as silicon, GaAs, etc. Fine line stencil masks (photomasks) provide the medium for patterning the silicon wafers with the multiple layers of circuit element geometries. Photomasks essentially consist of microphotographs of the individual circuit layers. Devices are produced by photolithographic techniques using photomasks on an oxidised silicon substrate which is coated with photosensitive polymers called photoresists or resists.

These resists selectively protect an underlying wafer substrate against chemical or physical attack. For many years now the transfer of design layout on the resist has been accomplished by optical systems (optical lithography) operating at visible light wavelengths, i.e. in the optical region of the electromagnetic spectrum. However, the increasing requirement of smaller geometric features for increased circuit packing density and operating speed, new techniques such as deep UV lithography, X-ray lithography and electron beam lithography have been developed.

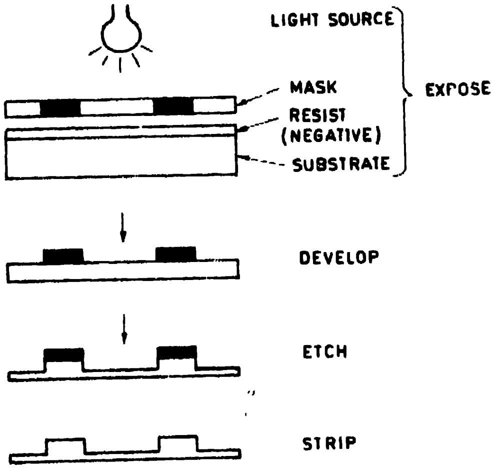

Fig. 1: A generalised photolithographic system.

A generalised photolithographic system is depicted in Fig. 1. The circuit to be replicated is delineated on a thin optically opaque layer, sprayed on a transparent substrate such as glass. This pattern called a mask is transferred on a resist coated wafer by a lithographic exposure system to form an aerial image which consists of a spatially dependent light intensity pattern in the vicinity of the wafer.

Having produced a mask, the next task is to transfer the patterns of each mask on to the wafer surface in order to delineate the regions of doping, insulation, contact windows and connection tracks. To achieve this, the wafer is coated with a light-sensitive film called photoresist or resist and exposed through the mask.

By exposing the resist coated wafer to the aerial image, the resist becomes more soluble (with a positive photoresist) to a chemical developer. This allows for easy removal of the exposed regions. This resist image remaining on the wafer behaves as a stencil for subsequent processing such as etching or metallisation.

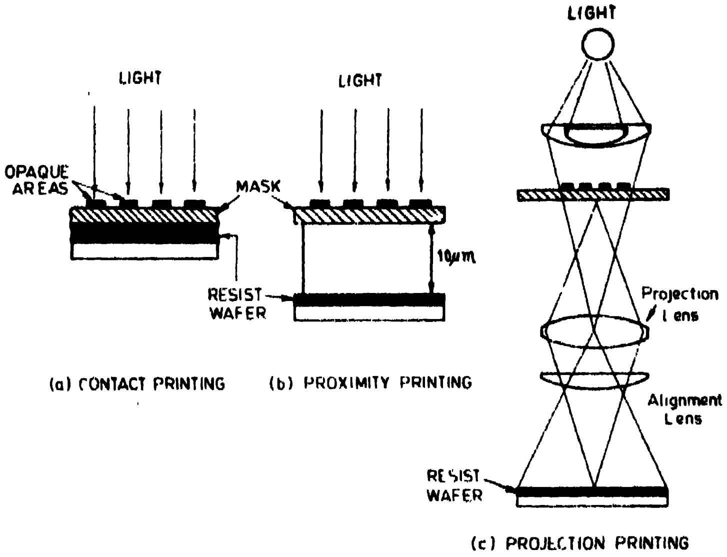

Fig. 2: Three methods of resist exposure: (a) contact printing; (b) proximity printing; and (c) projection printing.

A perfect lithographic process is achieved when the image is an exact replica of the mask pattern, i.e. the image is without loss of information or distortion. However, it is the nature of the physical or chemical process that a perfect lithographic system is hardly ever achieved. As minimum geometries or the wafer become smaller, the lithographic system becomes less ideal. This has stimulated the ever-increasing efforts to develop newer lithographic techniques, to keep pace with the ever-decreasing line widths associated with VLSIs.

Future lithography will be aided by the adoption of trends in processing like high contrast, dry process resists, more uniform wafer surfaces (e.g., multilevel resist structures), lower temperature processing of device wafers and mixed and match modes of lithography.

Optical exposure techniques

Exposure of the coated wafers through a photomask can be performed by any of the three methods shown in Fig. 2. These are: (i) hard contact, (ii) proximity printing, and (iii) projection printing.

Contact printing (Fig. 2a) brings the resist-coated wafer in physical contact with the mask and illuminates the back of the mask with actinic radiation. The wafer is held flat against a vacuum chuck while the back of the chuck swivels in a spherical socket. Contact is achieved by vertically moving the chuck assembly until the wafer is in intimate contact with the mask surface.

In proximity printing (Fig. 2b) exposure takes place with a finite gap between the substrates. During this process, the mask and wafer are separated by about 10 μm during exposure. This is done to reduce the damage resulting during contact.

Advantages

The inherent advantages in contact/proximity printing are the simplicity of the system, and a relatively small capital investment. Contact printing is capable of producing good 1 μm resolution (defined in terms of minimum feature that can be repeatedly exposed and developed) and proximity printing about 4.0 μm features. Since this technique requires a minimal number of optical elements and broadband illumination, higher exposure rates can be achieved.

Disadvantages

There are many limitations that affect the usefulness of contact/proximity printing in VLSI application.

1. The induced mask defects limit the mask life and hence the cost. Depending on the severity of the contact and the size of the die, the life can be from ten to hundred exposures.
2. The process of clamping the wafer between two substrates distorts the wafer surface in an unpredictable manner, making it difficult to get repeatable results.
3. Overlay errors as large as 1 μm are produced.
4. Since highly collimated sources of illumination are used to limit penumbra effects, the coherency in the collimated sources tends to accentuate diffraction effects in the imagery.

Proximity printers operate in the region of Fresnel diffraction where the smallest achievable feature is proportional to $(\lambda Y)^{1/2}$, where λ is the exposing wavelength and Y is the separation between mask and wafer. By decreasing λ, separation Y can be increased without loss of resolution. The operating wavelength of light is about 4000 Å. If this could be reduced to say 2000 Å, as in the case of deep UV region, the mask to wafer separation can be doubled and hence the yield can be improved.

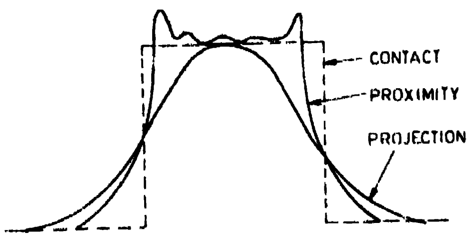

Fig. 3: Photoresist profiles.

Proximity printing provides considerable improvement in the line width control as compared to projection printing.

Projection printing. In order to avoid the damage of the mask due to contact printing, the mask image can be projected onto the wafer. Projection printing offers higher resolution than proximity printing and permits a large separation.

In projection printing, the image of the mask is projected [illegible] the wafer through a high resolution lens. The mask is usually illuminated in transmission and the demagnification of the lens may vary between 1 to 20 times.

A projection mask aligner can take many different forms, depending on the type of imaging lens used. Fig. 2(c) shows a basic refractive projection mask aligner to illustrate its component.

The advantage of projection printing is its non-contact operation that prevents the mask from introducing defects and wearing out. Besides saving the cost of making several replacement masks, the wafer images are potentially more uniform because a single mask is used for all of them. The non-contact operation also eliminates the need to move the wafer after it is aligned.

Another advantage can be gained when instead of 1:1 lens a reduction lens is utilised. The mask becomes easier to fabricate and repair. The use of a reduction lens usually reduces the head size which becomes smaller than the wafer and a step-and-repeat operation is required to cover the entire wafer. Though seemingly more complicated, stepping with a small field makes projection printing less susceptible to wafer in plane distortions.

In addition to the complexity and higher cost of a projection lens, the refraction type can only be corrected for one or two wavelengths. Standing waves are often produced in the photoresist image, making line width control more difficult.

(To be continued next month)

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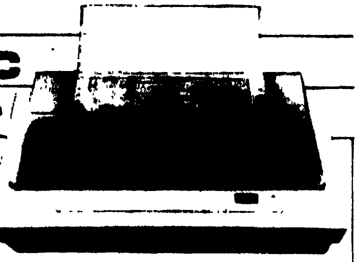

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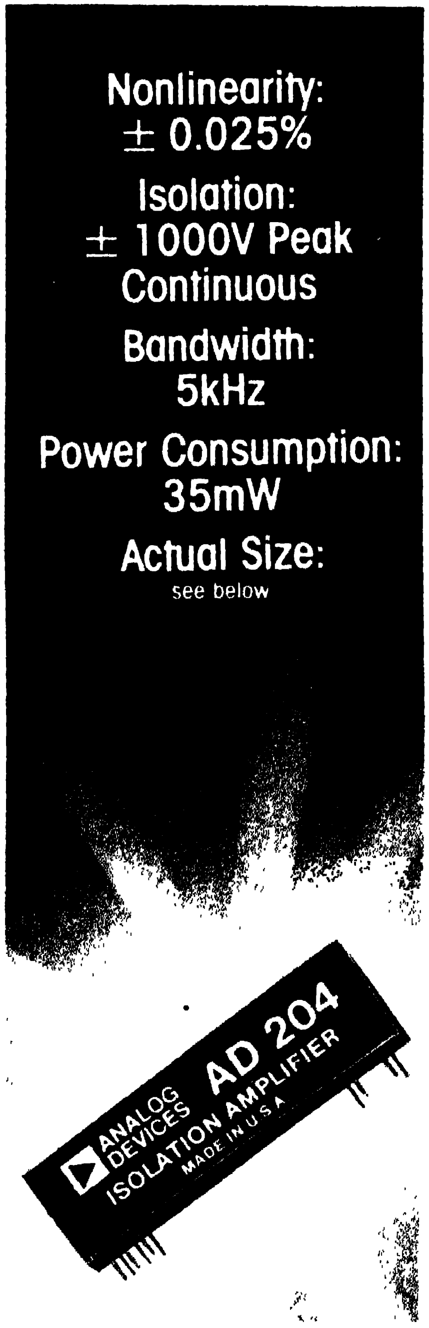
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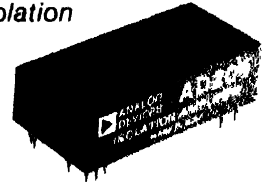

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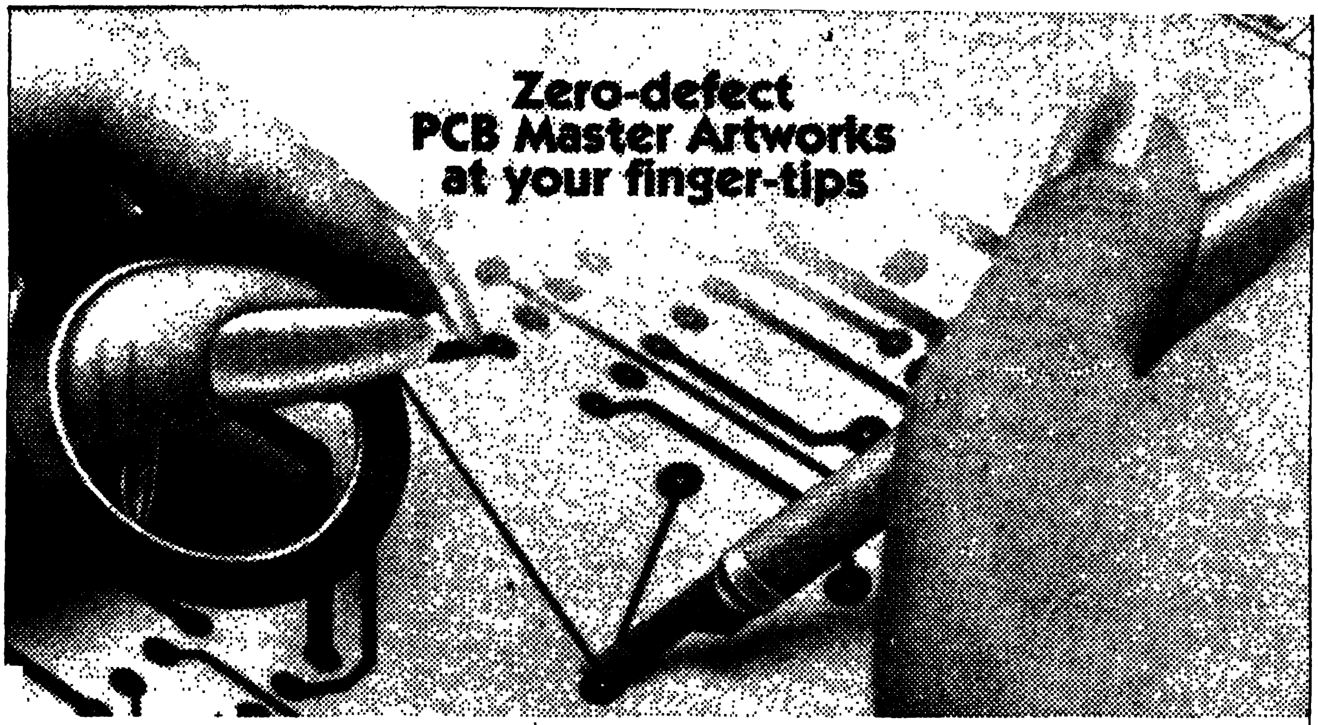

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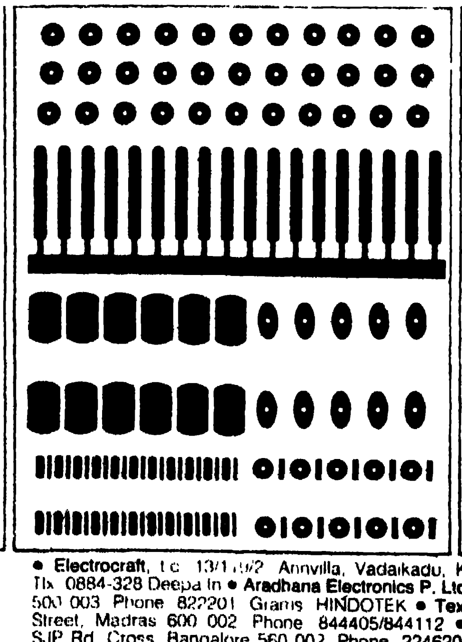

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High Voltage Power Supplies

Nagesh Upadhyaya

High voltage power supplies are special type of DC/DC converters used as power sources in many applications. They are special in that their design and fabrication involves exercise of extra care. Good design techniques result in high voltage power supplies of good reliability.

Following paragraphs give an overview of high voltage (HV) design fabrication and the special care which must be taken to evolve a reliable HV supply.

HV converter

A HV converter can be defined as a power supply where a DC at a lower level is transformed into a DC at higher level.

Basic HV converter can be thought of as being an inverter and a rectifier connected in series as shown in Fig. 1.

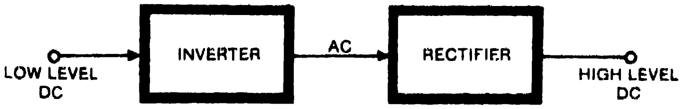

Fig. 1: Block diagram of a basic HV converter.

The inverter converts the DC at lower level to a higher level AC, by first changing the lower level DC to a lower level AC and then using a step-up transformer to get an AC at a higher level. Thus inverters are a special type of oscillators.

The rectifier at the output of inverter changes the stepped-up AC voltage to a DC voltage at higher level. To this basic HV converter, voltage multipliers are added optionally to get still higher voltages, than that got by a transformer without causing its breakdown. Filters and regulators can also be part of HV power supplies like any other low voltage power supplies.

Hence we have the following basic circuits to be discussed for a high voltage power supply (HVPS):

1. Oscillators
2. Rectifiers and voltage multipliers
3. Filters
4. Regulators
5. Controllers

OSCILLATORS

Out of the many circuits which can be used for inversion, the most popular are:

(a) Self-oscillating types. Here again we have two subsections: (i) chopper or push-pull circuits, and (ii) blocking oscillators.

(b) Driven types.

Self-oscillating circuits

In this type, no external drive is given to the switching transistors and they work on the principle of regenerative feedback. A portion of the switching voltage is fed back to drive the transistors.

A general form of push-pull type circuit is shown in Fig. 2. Both the primary and feedback windings are centre-tapped; the secondary can be centre-tapped, if required. T1 and T2 are used as switches to alternately cut on and off the DC (i.e. Vcc) to produce chopped output at the primary and hence at the secondary. Due to the feedback action, either T1 (or T2) will be conducting at a time and T2 (or T1) will be off. Once T2 (or T1) cuts off, T1 (or T2) will start conducting. This produces a symmetrical square waveform at the T1, T2 collectors and secondary as shown in Fig. 3.

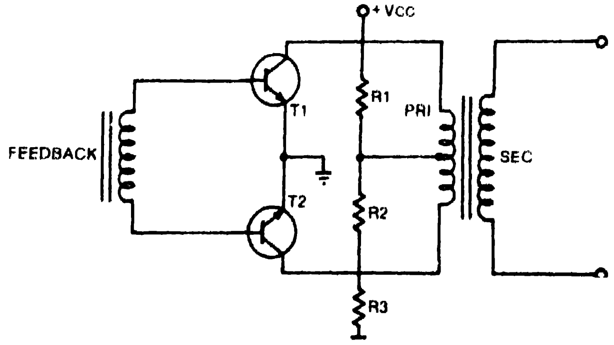

Fig. 2: A typical push-pull circuit.

This circuit has advantages, that (a) very symmetrical waveforms are observed at the output, and (b) core satura-

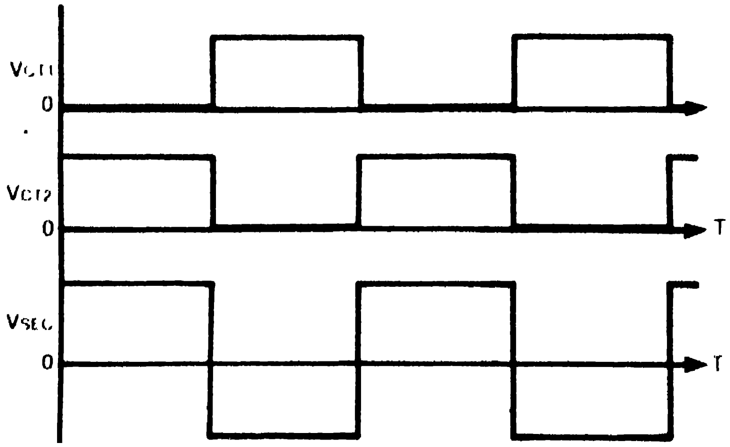

Fig. 3: A symmetrical square waveform produced by a push-pull circuit.

tion is avoided because the transformer is centre-tapped and the core is driven equally in both the directions.

However, the circuit has the disadvantage of higher standby losses and the centre-tapped transformer winding design requiring bifiliar arrangement of wires.

A general form of blocking oscillator circuit is given in Fig. 4. With power on, there is a zero bias on the transistor

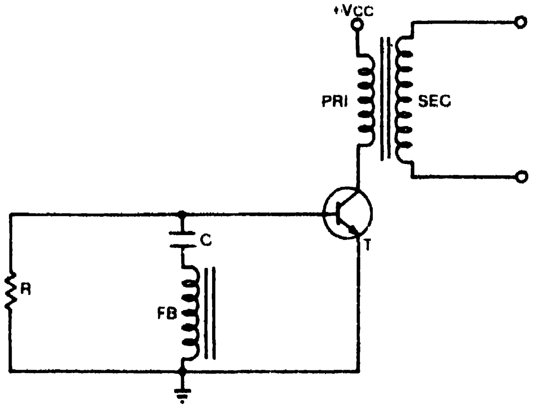

Fig. 4: A typical blocking oscillator circuit.

(T). The collector current starts with leakage in the transistor. Primary rate of change of current induces a voltage in the feedback, which gradually drives 'T' to saturation. At saturation, change in collector current ceases, feedback stops and transistor cuts off, negative voltage existing on the capacitor at the base gets discharged through R, and again the above process repeats.

This produces waveforms at collector of T and secondary as shown in Fig. 5.

As seen in the waveforms at Fig. 5, blocking oscillator design produces slightly unsymmetrical pulses. Even this could be improved by redesigning and adding some other circuit elements, at the cost of extra power. This exercise is not really necessary. The slight asymmetry in the waveform does not matter much, because finally the AC is going to be converted back to DC. More important, standby power can be kept at a lower level in certain low power applications.

Driven type oscillators

This is characterised by an external oscillator driving the final on/off switches connected to the transformer primary. Here also there are two types, single-ended and push-pull, as depicted in Figs 6(a) and 6(b) respectively.

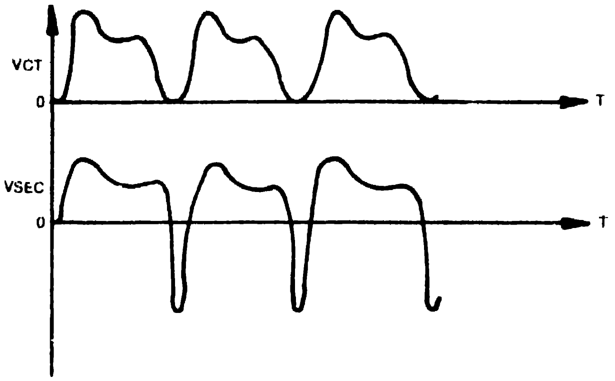

Fig. 5: Output pulses from the collector blocking oscillator transistor.

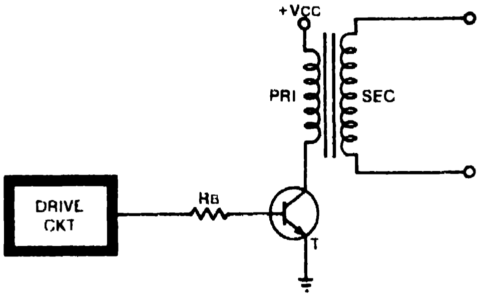

Fig. 6(a): Single-ended driven type oscillator circuit.

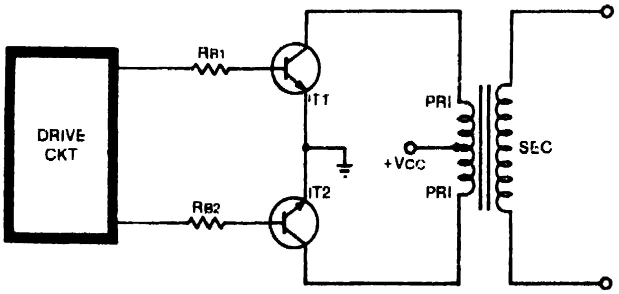

Fig. 6(b): Push-pull driven type oscillator circuit.

Driven-type oscillators have higher standby losses compared to the self-oscillating circuits.

Based on the above discussion, it can be said that, self-oscillating blocking oscillator circuits are used for low-power converters; self-oscillating push-pull types are for medium power applications and driven-type circuits are used for high power sources. In lower power applications, it is necessary to see that the circuit losses do not become comparable with the output power.

Thus the design of an oscillator consists of the following elements:

(a) Choice of switching transistors;
(b) Choice of switching frequency; and
(c) Choice of core and design of transformer.

Choice of transistors

The basic requirements regarding this are: (i) it should be a high frequency transistor, and (ii) it should have higher breakdown voltages.

The second requirement is necessitated because of inductive reactances encountered in the circuit at the primary and feedback. That is to say, transistor should be capable of withstanding high back-emf spikes produced during switch-off of inductors. A rule of thumb is that $V_{CE(max)} = 2V_{CC}$.

If $V_{CC} = 15V$; then $V_{CE(max)} = 15 \times 2 = 30V$.

Further, in switching applications, it is taken that switching power can be about eight times the normal class-A power rating, because during switching operation, the current flow is not continuous.

Hence $P_{SW} = 8P_{AV}$

If P_{AV} = 800 mW, then $P_{SW} = 8 \times 0.8 = 6.4W$.

That is, a transistor of 0.8W power rating can be expected to switch up to a maximum of about 6.4W.

A medium hfe transistor can be chosen, since amplification is not a criterion here.

Choice of frequency

This is a trade-off between various aspects. If the frequency is too low, then core size tends to increase; if it is too high, then standby losses in oscillator and core increase. The oscillator frequency is also likely to interfere with other systems, through conducted and radiated emission. So a careful selection, avoiding of frequencies of other systems connected to the same power line, is required.

In general, a frequency of around 2 kHz is used for low power applications, whereas a frequency of about 20 kHz is taken as suitable for medium power applications. Still higher frequencies are being tried out for higher power applications, with power MOSFETs as switches.

Choice of core and design of transformer

There are many types of cores available such as laminated cores, ferrite cores and toroidal cores.

Laminated cores have higher losses at the operating frequencies of the converters and hence they are avoided.

Ferrite cores are fragile; they cannot withstand vibrations and shocks. When reliability is important, ferrite cores fail to satisfy the conditions.

Toroidal cores are best suited for converter applications. These are also known as tape-wound cores. They have minimum flux leakage and hence losses because of their closed magnetic loop structure. A typical cut-away section of torodail core is shown in Fig. 7.

Tape material of the core may vary, as also the tape thickness. Tape material is usually an alloy of iron like deltamax, mumetal, permalloy etc. Tape thickness determines the maximum usable frequency of the core.

As an example, a kind of molybdenum-permalloy has 80 per cent Ni-Fe and 4 per cent Mo as its major constituents. It is recommended for high frequency applications and saturable reactors. Its speciality is that it has high initial permeability, low core loss, low coercive force etc. Regarding tape thickness, some manufacturers have specified that a 0.025mm thick tape can be used for frequencies up to 10 kHz; 0.013mm can be used up to 20 kHz etc.

The core breakdown strength is also an important factor while designing HVPS. It should be at least twice the peak-to-peak voltage appearing across the transformer secondary.

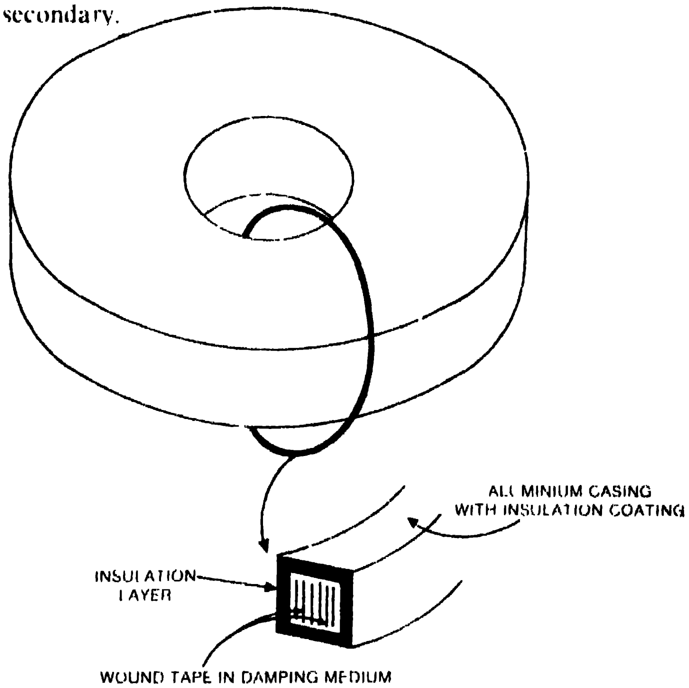

Fig. 7: Cut-away section of a toroidal core.

Enamelled copper wires of suitable SWG are wound on the core. Overlapped winding configuration can be used with primary, feedback and secondary coming one above the other. Bifiliar winding gives better results. The size of the core depends on the power output, window area, the turns ratio etc. Turns ratio depends on the output voltages required and output power determines the guage of the wire. In HVPS a turns ratio of 1:20 is not uncommon.

The step-up ratio, if too high, causes breakdown in the secondary winding and hence very high step-up ratios are avoided. Insulation tapes are provided between different layers in the secondary of the transformer. Transformer design starts with the design of primary number of turns. Knowing the frequency of operation, supply voltage and core flux density (B_{max}, specified by the manufacturer) we can calculate the primary turns by the given formula

$$N_P = \frac{E_{(av)}}{4 B_{max} f \times 10^{-8}} \quad \text{for non-sinusoidal waveforms}$$

To calculate the feedback turns (N_F), the following rule of thumb is used

$$\frac{1}{5} < \frac{N_F}{N_P} < 1$$

that is, feedback turns must be more than one-fifth but less than the number of turns in the primary.

To decide the secondary number of turns, it is required to know secondary current, guage of wire, window area of the core etc. 'Window area' is the area in the core which can accommodate all the three windings. Therefore when winding the secondary, the area already occupied by primary and feedback has to be taken into account. With thinner guages of wires it is found that practically a ratio of 30 to 40 can be accommodated, depending on the step-up ratio required, i.e.

$$\frac{N_s}{N_p} \simeq 30 \text{ to } 40$$

RECTIFIERS AND MULTIPLIERS

Any of the rectifiers used for low voltage power supplies could be used for HVPS as well. However, care has to be taken for device selection of higher ratings. Minimum two times the worst case operating condition of a device can be taken as a good device derating factor. For example, if a HV capacitor is subjected to say 600V DC as the worst-case condition, then the minimum working voltage of that capacitor has to be 1.2kV DC.

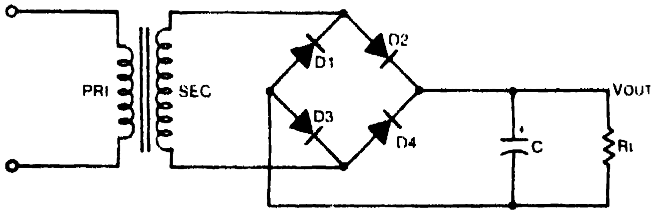

Fig. 8: A full-wave bridge circuit for HVPS.

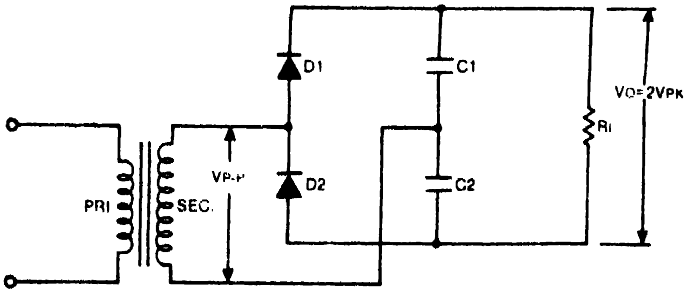

Fig. 9: A conventional voltage doubler circuit.

Depending on the application, a half-wave, full-wave, doubler or tripler can be used in HVPS. For example, a full-wave bridge circuit for HVPS shown in Fig. 8 is no different from that for a low voltage power supply. Note that D1-D4 and C are high voltage diodes and capacitor respectively.

In most cases, the secondary voltage is doubled, tripled or similarly multiplied. A conventional voltage doubler circuit is given in Fig. 9.

However, in practice an n-stage multiplier will be used to get higher voltages. Two most popular circuits in this are parallel multipliers and series multipliers (cockroft-walton circuit).

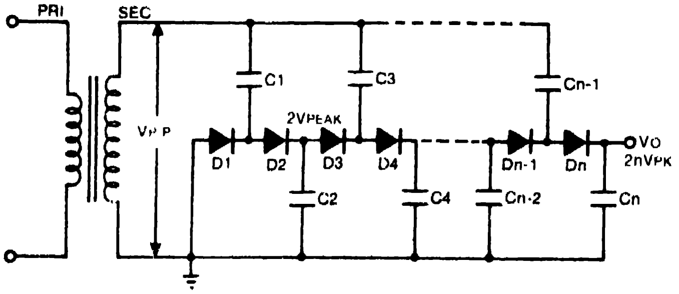

Fig. 10: The circuit for parallel multiplication.

As can be seen in the parallel multiplier circuit (Fig. 10), devices at the later stages have to be of higher voltage rating (almost load voltage). Further, there is no advantage with respect to device reduction or ripple. Hence series multipliers are used.

In a series multiplier circuit (Fig. 11), a maximum voltage of 2 VPK only appears across any device. Hence this circuit is advantageous in using devices of lower ratings. The capacitors used in this are approximated by $C=9 V_O^2 I_L / 2f(V_{p-p})^3$, where I_L is the load current, f is the converter frequency and Vp-p is the peak-to-peak (2VPK) secondary voltage.

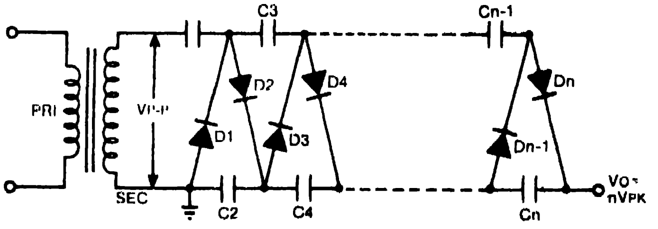

Fig. 11: The series multiplier circuit.

The following points are worth noting with respect to multipliers:

(a) For a given load, as the number of stages are increased, the efficiency goes down;

(b) Increase in number of multiplier stages increases the

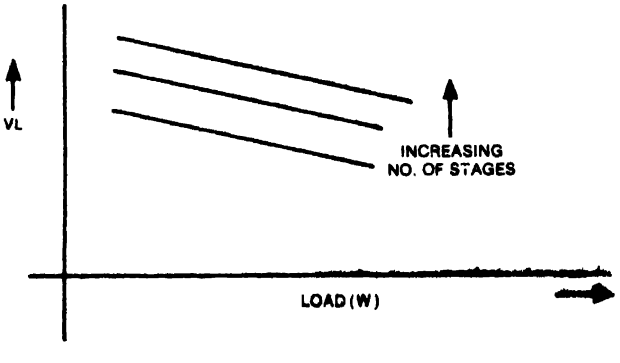

Fig. 12: Load supply vs load consumption characteristics for different number of multiplier stages.

output but the output power that could be supplied comes down linearly (Fig. 12).

Thus the number of multiplier sections have to be optimised. Taking into account the losses encountered in the high voltage sections and to supply any bleeder current, if required, an extra section or two can be incorporated.

FILTERS

Once the DC is available at the output, the next problem is to reduce the AC content in it. That is, filtering. This can be achieved by any one of the standard filter circuits.

Even though L-C filters can be used, by their very nature inductors are bulky which increases weight and space of the system. At lower currents, R-C filters are effective and can be used with advantage.

Simple R-C filters shown in Fig. 13 will serve the purpose. The number of R-C stages required depends upon the ripple that is tolerable in the system. The R and C values can be optimised by referring to charts of ripple attenuation versus R_{CF} for different filter sections. One such useful chart is available in 'Electronic Engineer Handbook' by Landee and Davis (McGraw Hill), whose general form is shown in Fig. 14.

At low-current applications, four to five sections of filters reduce the ripple to acceptable values of 10-20mV. Also, it is found that, metal film resistors in place of carbon composition resistors give improved noise performance because of their uniform structure. Good grounding and shielding is also required. Shielding between multipliers and filters as also between oscillators and filters gives good improvement regarding ripple characteristic.

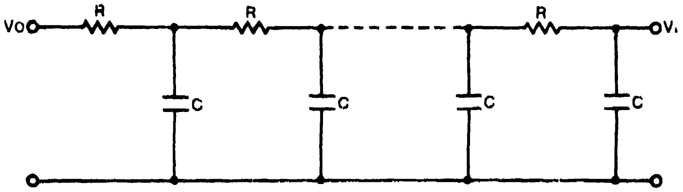

Fig. 13: Simple RC filters.

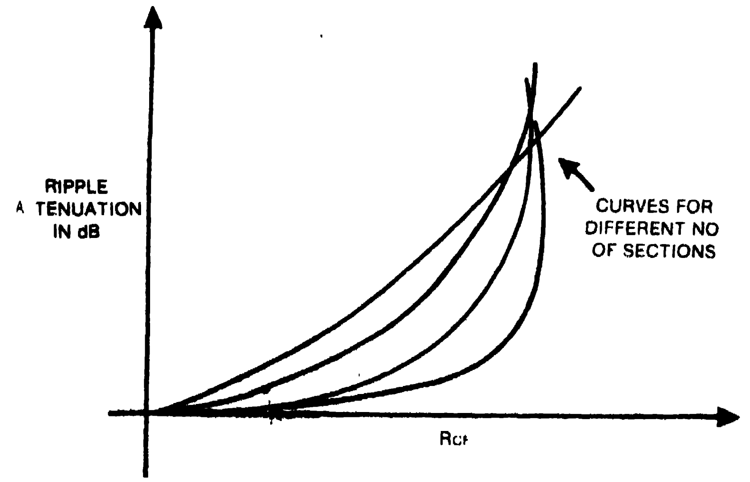

Fig. 14: General waveforms of ripple attenuation.

REGULATORS

Here we can study two types of regulators:

(a) Gas-tube regulators (VR tubes), and

(b) Feedback regulators.

In gas tube regulators, the phenomenon of gas breakdown is utilised for regulating the load voltage. Gas tube is the vacuum tube counterpart of zener diodes. Tubes are connected as shown in Fig. 15. When there is an increase in the voltage, the current (I_Z) through the tube adjusts in such a way that load voltage is kept constant.

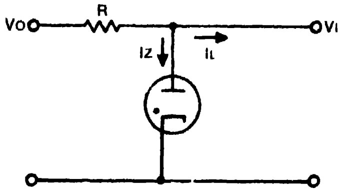

Fig. 15: Vacum tube regulator circuit.

However, tubes are bulky, fragile and occupy more space. Also, since the tubes work in open-loop mode, they do not regulate voltages lower than their own rated voltages. Further, tubes require biasing currents for gas breakdown and regulation. This adds to no-load losses.

Feedback techniques are preferred because they are closed-loop error detection and correction methods. If designed properly, they give very good regulation. Here an amplifier is used in the feedback. Load conditions are sampled and the sample is summed at the input of the amplifier with a constant reference. The amplifier output is made to vary in accordance with load conditions. Here again there are two types, namely voltage controlled and current controlled systems. The general form of voltage controlled system is shown in Fig. 16.

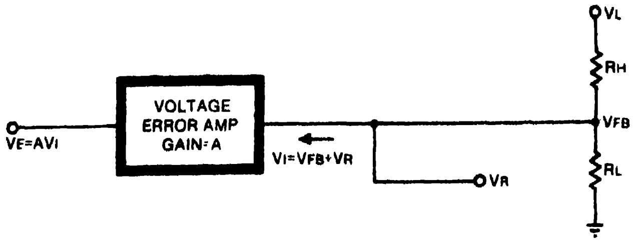

Fig. 16: A typical voltage controlled system.

Load voltage is sampled at V_{FB} using high value resistor R_H and low value resistor R_L. This is summed at V_I with a stable reference voltage V_R. Since the reference is constant, V_E varies in accordance with load voltage V_L.

Current mode control feedback loop system is more com-

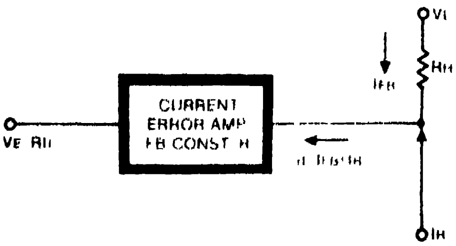

Fig. 17: The circuit for current mode control feedback loop system.

monly used as this simplifies the feedback loop to a one-pole system, which provides reduced phase shift and a more stable loop. Fig. 17 is the general form of this type of circuit.

Load current is sampled using a high value of resistor (RH). This current (IFB) is combined with a stable reference current (IR), giving a total current of II which is transformed to a voltage (VE) using an error amplifier acting as a current-to-voltage converter When there is a change in load, bleeder current (IFB) increases or decreases depending on the load conditions. This causes a change in error current (II) which in turn changes error voltage (VE).

This error voltage change from either of the systems described above is made to control the drive of the oscillator circuit in such a way that, depending on load changes, the drive to the oscillator increases or decreases and hence the terminal voltage remains at a constant level.

CONTROLLERS

Drive control can be either by amplitude variation or by frequency variation.

The simplest form of amplitude controller is a series pass transistor as shown in Fig. 18. The base drive of transistor is varied by VE which gives a varying VA at the emitter. Hence the input supply voltage VCC is varied in accordance with error voltage to give a controlling output. The disadvantage here is the power dissipated in the series pass transistors. But the control is simple.

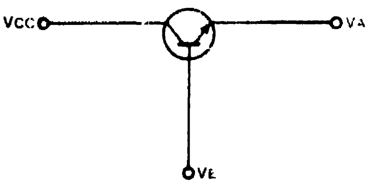

Fig. 18: A simple form of amplitude controller.

In frequency control methods, on/off times of the output transistors are varied in accordance with error voltage. Higher the error, more is the transistor on time. This gives a higher output, correcting the reduced output voltage. This method is advantageous as it gives better regulation and efficiencies. Known as pulse width modulation (PWM) technique, it is the latest in the field of high-power, high-efficiency switchers. A single IC does the job of this PWM.

Now we can see some of the miscellaneous aspects, problem areas and special precautions to be taken in HVPS.

Losses

Following are the losses encountered:

(a) Losses in regulating circuits, error amplifiers etc (i.e. losses in associated circuitry).

(b) Losses in the transformer cores.

(c) Losses in diodes, capacitors and resistors of high voltage multiplier and filter sections (switching losses).

(d) Losses due to stray capacitance in the transformer windings.

Avoiding HV discharges

Corona and arcing are the most common problems under HV discharges. Following steps have to be taken to avoid these:

(a) HV sections are to be separated from low voltage sections in the power supply.

(b) Isolation has to be provided with input transformers and optocouplers.

(c) HV components have to be highly derated and choosing components specially manufactured for HV applications is a better design practice.

(d) Surfaces of cards etc where HV sections are wired, have to be clean and without any deformities.

(e) HV printed circuit card layouts have to be specially done to avoid any sharp corners, as this may lead to corona discharges.

(f) HV lines and ground lines have to be spaced as wide apart as possible to avoid arcing.

(g) Components spacing should also be taken care of so that the HV points and low-voltage points do not come nearby.

(h) HV transformers have to be well insulated.

(i) Solid encapsulants or potting compounds have to be used to cover the HV sections.

(j) Voids or discontinuities in the potting compounds have to be eliminated.

(k) To avoid damage to the components because of corona or arcing, additional circuitry has to be incorporated to detect these and shut off the HVPS.

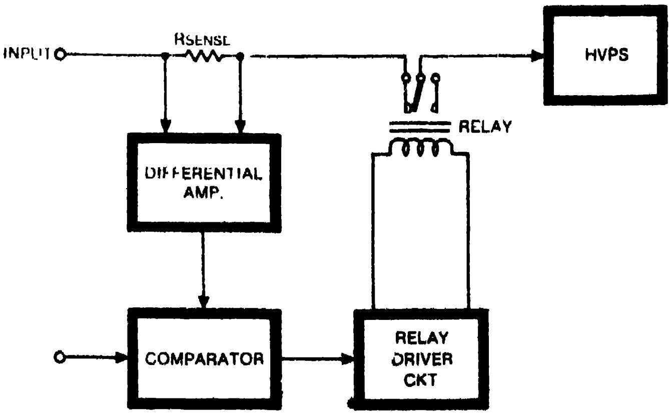

Fig. 19: The current sensing circuit to detect sudden rise or fall in current.

Incidentally, corona/arcing is detected by either a sudden rise in the input current or a drop in load voltage. To detect this, a simple current sense circuit at the input can be incorporated as shown in Fig. 19.

Safety procedures in testing and handling of HVPS

(a) HVPS have to be located at isolated places where there is minimum movement of personnel in the testing area.

(b) Red danger boards have to be made in both local language and English, and they have to be displayed at prominent places while HV testings are being carried out.

(c) HVPS should never be kept on in the absence of testing personnel and HV points should be well insulated.

(d) Persons should be educated about the hazards of HV shocks.

(e) Well insulated and rated equipment have to be used for HV measurements.

(f) Built-in bleeders have to be provided for discharging HVPS when put off in the absence of loads.

(g) Only qualified pesonnel should handle HVPS.

(h) Special HV cables have to be used for HV connections, thus avoiding any leakages.

Finally, we study some aspects which are considered crucial in the functioning of HVPS. Here an attempt is made to define and differentiate some of the terms which are mostly heard in connection with power sources.

Corona

When the voltage gradient between two electrodes exceeds a certain critical value, there is ionisation of air surrounding the conductors, and a luminous discharge occurs. This is known as Corona.

Corona onset voltage is governed by a law known as Paschen's Law. Paschen's Law states that, in a uniform field the corona onset voltage is dependent on both the pressure and the distance between the electrodes. Thus,

$V_s = f(p,d)$

The general form of corona onset voltage as a function of pressure times distance is given in Fig. 20.

We can see that as the pressure is decreased or distance between electrodes is decreased, corona can occur at lower voltages. But after reducing the pressure to a certain level, the corona onset voltage again increases. This is because at higher vacuum, there will be lesser number of free molecules to cause corona.

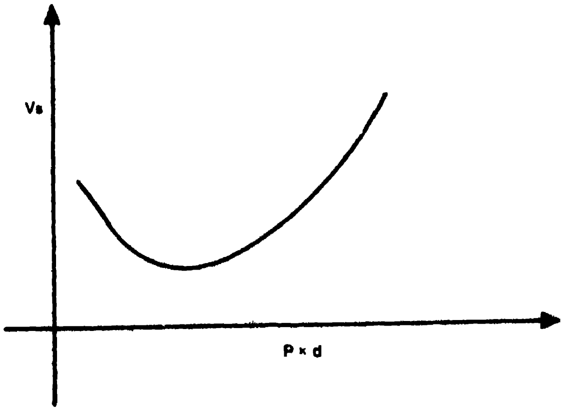

Fig. 20: A curve indicating the general form of corona onset voltage.

Corona is a localised discharge and is limited to the region surrounding the conductor in which the electric field exceeds a certain value.

Corona is characterised by a bluish purple glow in the vicinity of the electrode with smaller radius of curvature. Also, there is an abrupt increase in the current flow from one electrode to the other.

For a self-sustaining corona discharge, the ratio of effective local field to gas pressure is an important factor. It occurs in the nearness of conductors of small radius of curvature subjected to non-disruptive, intense electric fields such as electrical power lines, sharp points at high voltages, etc.

Though corona is responsible for power loss, RF noise and insulation faults, it finds applications in dust precipitation, electrostatic painting, commercial generation of ozone, telecopying etc.

Arc

This is defined as a discharge of electricity through a gas, normally characterised by a voltage drop in the immediate vicinity of the cathode approximately equal to the ionisation potential of the gas.

Arcing is a continuous luminous discharge of electricity across an insulating medium. During arcing usually there is a partial volatisation of the electrodes. Fig. 21 shows a typical curve, which indicates the transition to arcing.

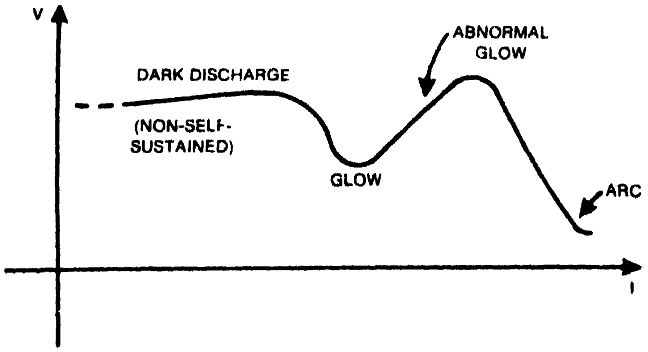

Fig. 21: A typical curve indicating transition to arcing.

Dark discharge sets on with breakdown voltage. After this voltage, the current increases rapidly. With the occurrence of space charge phenomenon, the discharge passes through various stages of glow discharge, and finally when the voltage increases again discharge goes into arc region.

It should be noted that the power supply connected to the electrodes should have both a high voltage and sufficient power for the maintenance of an arc and that the highest voltage has to be applied for the short duration. Thus an arc can be formed by making the two electrodes come into contact with each other and then separating them. The thermionic emission at the cathode forms the arc and because of power supply, arc is sustained when electrodes are moved away.

Arc is characterised by high current density, high luminosity and fast-potential changes in front of the electrodes. Also, if the gap between the electrodes is already ionised, a lower voltage is required to strike an arc.

Spark

It is a disruptive discharge. Sparking occurs when there is a sudden and large increase in current through an insulating medium due to the complete failure of the medium under dielectric stress. Spark generation is by the physical contact of two electrodes at different potentials. Sparking is a discontinuous or a non-sustaining phenomenon in that once the electrodes are firmly in contact with one another, sparking ceases to exist till the time the electrodes are separated again. Only at the time of making or breaking an electrode-to-electrode contact sparks are observed.

Sparking is characterised by brilliantly luminous phenomenon of a short duration With sparking there is a flash of light. Sparking is also known as sparkover. □

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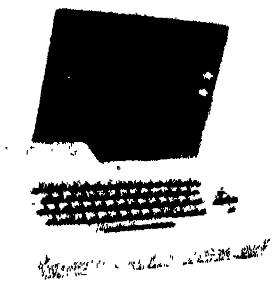

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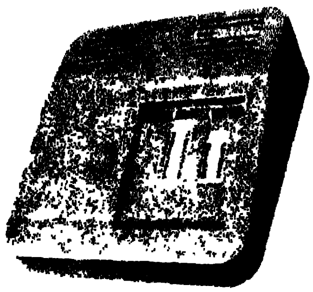

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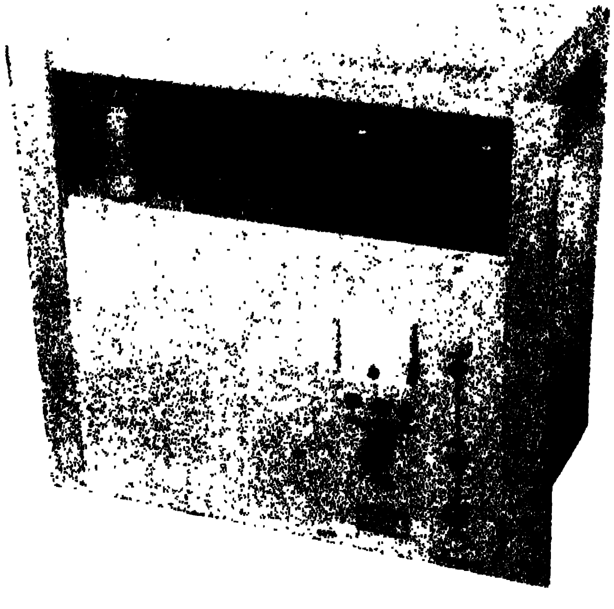

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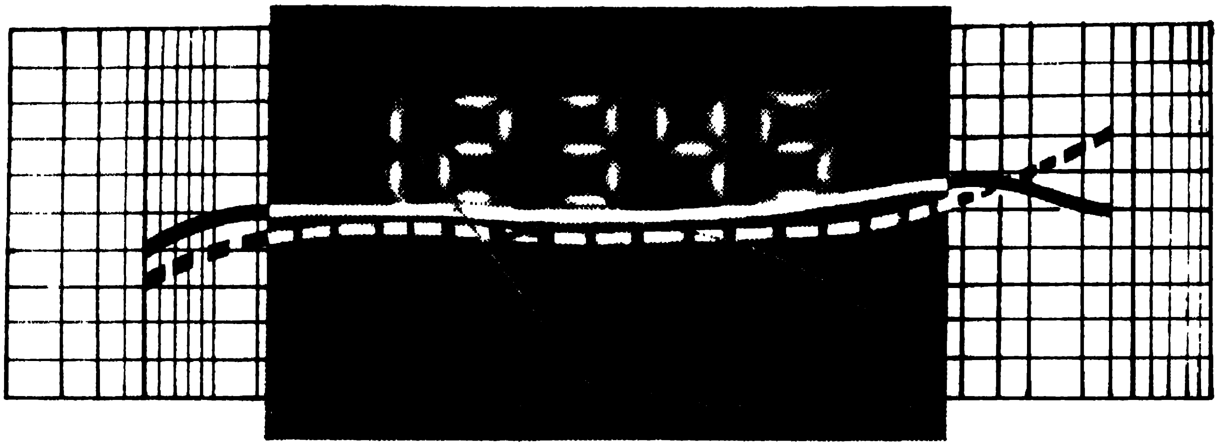

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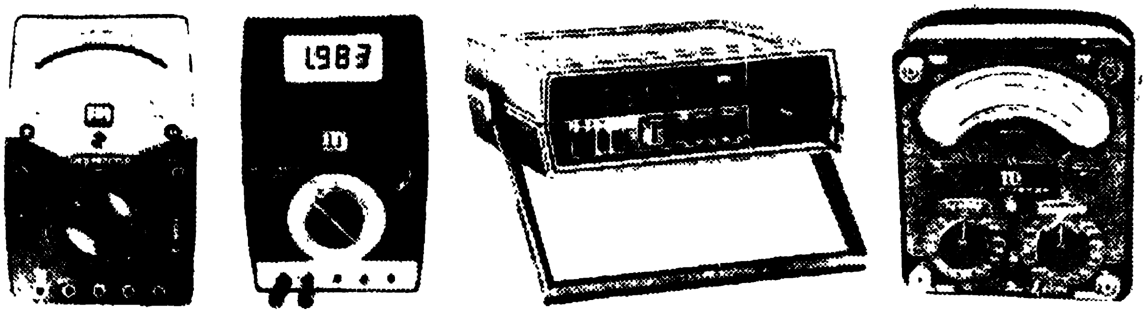

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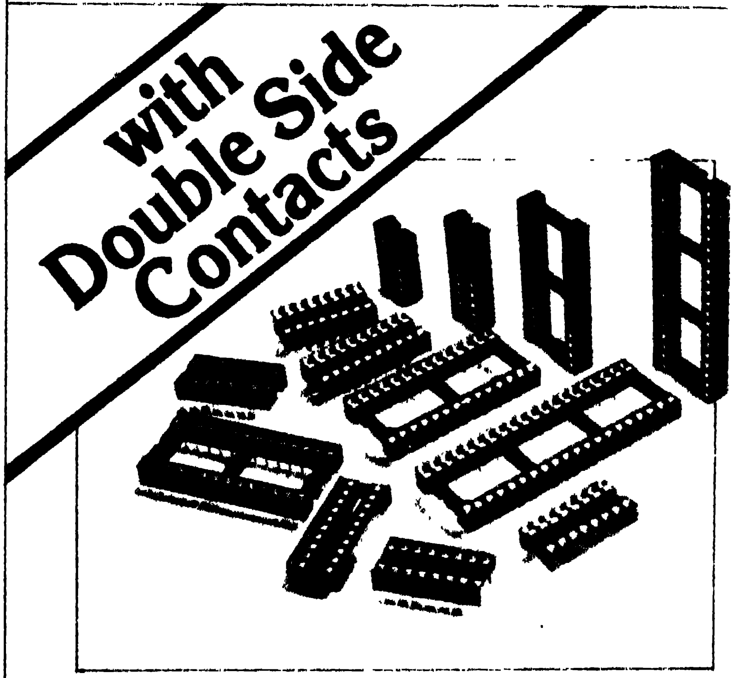

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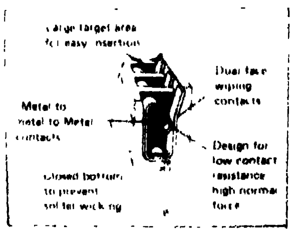
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A Zero-Cost, Infinite-Life Soldering Iron

For Electronics Experimenter

P. Narasimha Rao

The wide variation prevailing in the supply voltage (152-275V) has become more a common thing than an oddity in our metropolitan lives. It is a miracle how any simple, reasonably priced electrical equipment (without any sophisticated protection device) can survive long enough to pay back the investment made on it!

The soldering iron, for example, which is widely used by electronic experimenters is one victim of this. There are instances of burnt out soldering irons even within the first 30 minutes of their maiden life. An average electronics hobbyist is likely to have a good collection of burnt out soldering irons even after many attempts at reconditioning. In my junk box, I have a Henly 65W, a Sushma 35W, Tony 100W and 35W and more than half a dozen deluxe 10Ws of different brands—all rusting and useless.

Sometimes the time spent in reconditioning these irons with new elements doesn't seem worth compared to the cost of the replacement-element, the labour involved and above all, its subsequent service life. This is the situation we face frequently even if we operate these devices through a voltage stabiliser. Many times, operating a soldering iron without failure has come to be more of a problem than the fabricated equipment.

In this article, a method of reconditioning damaged soldering irons to carry on the hobby without tears is given.

The way out

The secret of the remedy lies in replacing the existing element of the soldering iron operating off 220V by an element prepared by the experimenter out of the nichrome ribbon-element wire salvaged from any burnt out and discarded element of domestic electric irons. The only inventory involved is a scrapped 10W deluxe soldering iron and a discarded element of a domestic electric iron, both of which are likely to be in the collection of our electronics hobbyists' junk box.

One more item needed to provide the necessary supply to operate the gadget is a main's transformer (any wattage above 20W) salvaged from one of the condemned or abandoned old valves-operated mains radios now obsolete. This may not be a problem; any experimenter handling electronics for a long time can easily find one in his junk or the item can be procured from any old radio service shop. The secondary HT leads of this transformer should be cut short and the shortened ends should be properly isolated and insulated. A 230/12V, 3A transformer may serve the need as an alternative.

How to rig up

The construction details pertaining to a 10W, deluxe type soldering iron, a popular type for the present-day electronic work involving ICs, are given here. Once the technique is mastered, one can apply it to any type of soldering iron, of any wattage with some modification. The steps involved are as follows:

First, dismantle the scrapped 10-watt deluxe type soldering iron (Fig. 1), carefully salvaging all the components including the ceramic beaded lead-in wires attached to the burnt 220V, 10W element. Check the copper soldering bit for oxidation and pitting. If much pitting is observed on the flat portion of the copper bit after scrapping all the oxide scales, better take another one.

Next, carefully salvage the ribbon-element wire (nichrome) from the burnt domestic electric iron element (say, 600-watt) specifically choosing that portion of the element which has not lost its metallic lusture. Measure a length of 35 to 38 cm of this element, remove all the kincks and folds and determine its electrical resistance (the low resistance range of your H-20 or P-3 multimeter can do the job). Cut the wire to such a length that its resistance is 7 to 8 ohms. Preserve some of the mica of the element not damaged due to excess heat for use later as an insulating medium between the nichrome element wire and the copper bit.

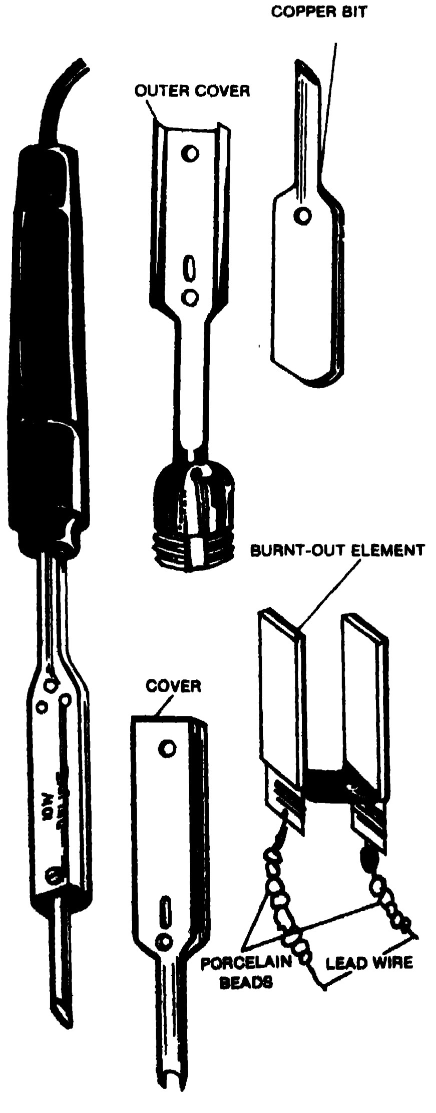


Fig. 1: Soldering iron disassembled.

Wrap one-and-half layers of a very thin rectangular sheet of this mica around the flat part of the copper bit to cover it. Since the voltages involved are going to be very low (11.3 to 12V), and there is no risk of shock, this mica can be as thin as possible, sufficient only to eliminate physical contact between the nichrome wire and the copper bit to avoid short-circuit. This ensures low resistance to heat transfer and high efficiency in operation of the soldering iron.

Next, wind the 35-38cm flat element wire around this mica-wrapped copper bit as shown in the Fig. 2, initially running a portion of the beginning of the wire (about 4 to 5 cm) between the first full layer and the extra half layer. Then completely wind the entire length of the 35-38 cm long wire in the form of a single layer coil, as close as possible, without adjacent coils touching each other to avoid any short-circuit. This covers almost the entire length of the flattened portion of the copper soldering bit below the hole meant for securing the bit to the iron sheet metal covers. The final end of the element wire, after winding, may be secured by making a small hole at the bottom projection of the mica-wrapping and by passing out the wire end through it.

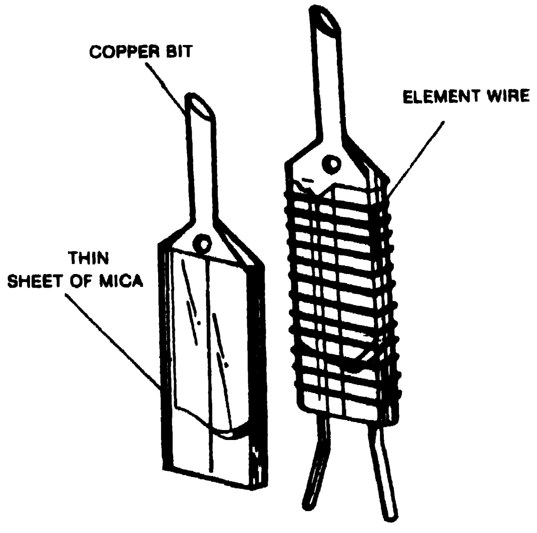


Fig. 2: Winding details on copper bit.

Now attach the ceramic-beaded lead wires to the two ends of the wound element wire and isolate the free ends to prevent them from touching each other as well as the iron metal, by placing thick folded mica pieces around the twisted ends.

Once again wrap around this finished element a thick sheet of mica and secure it to the element wound around the bit firmly by winding a few turns of 30SWG copper enamel wire (taken from the secondary of any burnt out output transformer or a damaged tubelight choke) in the form of helix, twisting the ends together. With this the major job is over; the rest of the work is just conventional, which is done as if you are replacing the element of your soldering iron.

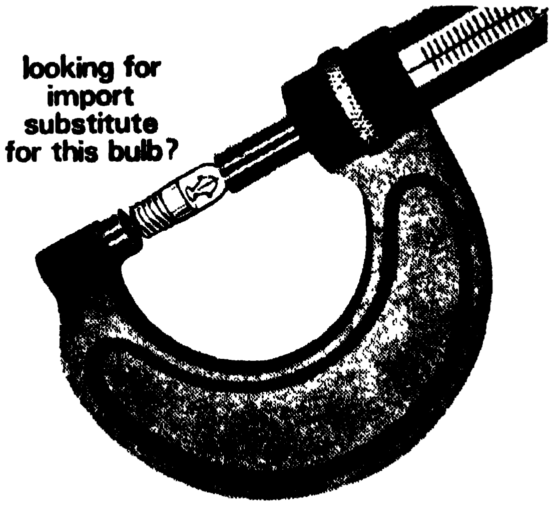
Bring out the ceramic protected element leads throughout the bakelite handle. Place the old asbestos padding on either side of the reconstructed element, carefully match the copper bit hole with those of the sheet metal body covers and assemble the parts Secure them in position by the screw and nut, putting washers on either side. Attach the element lead wires to the supply cable as done originally, to finish the work.

Test the construction for any short circuits, and if every thing is alright, give the supply of 12V AC and look for the heating of the bit tip. The heating time and the efficiency of operation depends upon how neatly the job is done, and the thickness of the mica-insulation given between the bit copper and the element wire.

The whole operation takes just a couple of hours. Since there is nothing to lose, you can make a few trials in improving the work which will certainly reward in the long run.

The current flow through the iron would be around 1.25A to 1.5A, which is much below the amperage of the element wire. This ensures long life and rugged operation, and you can carry on soldering without any fear of burning it, that usually lurks in the minds of the hobbyists.

□



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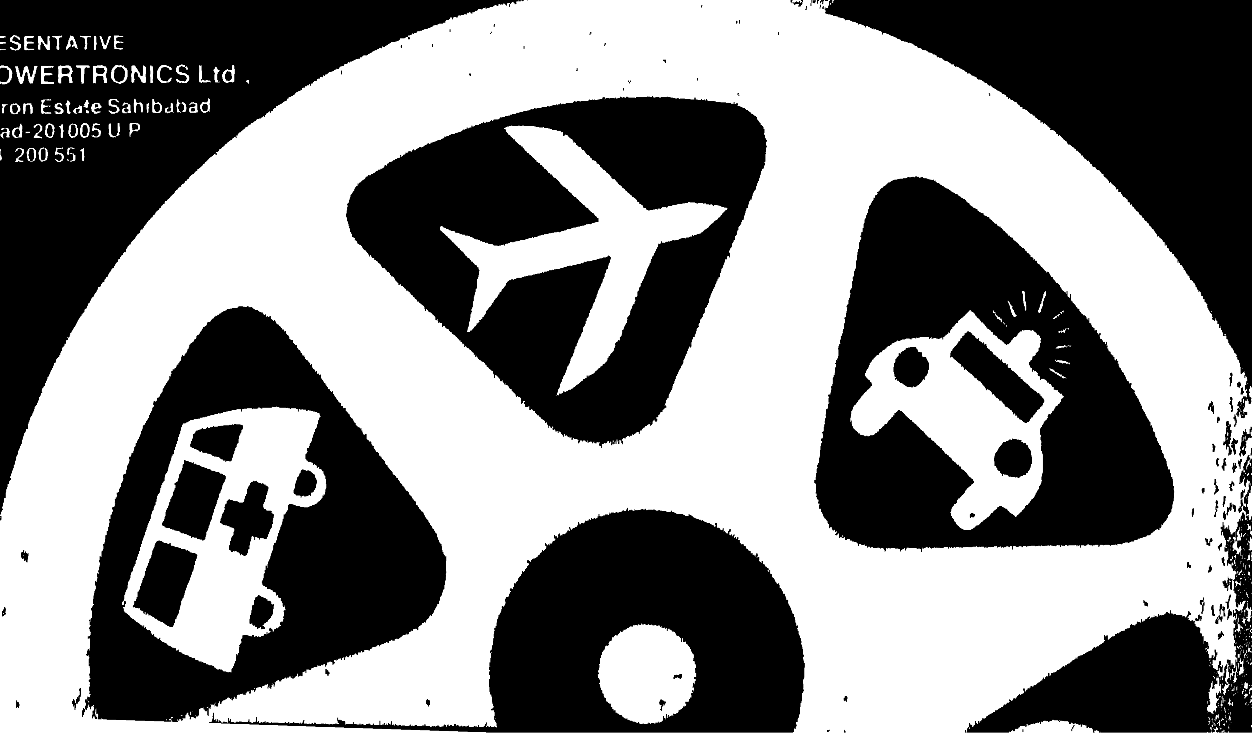

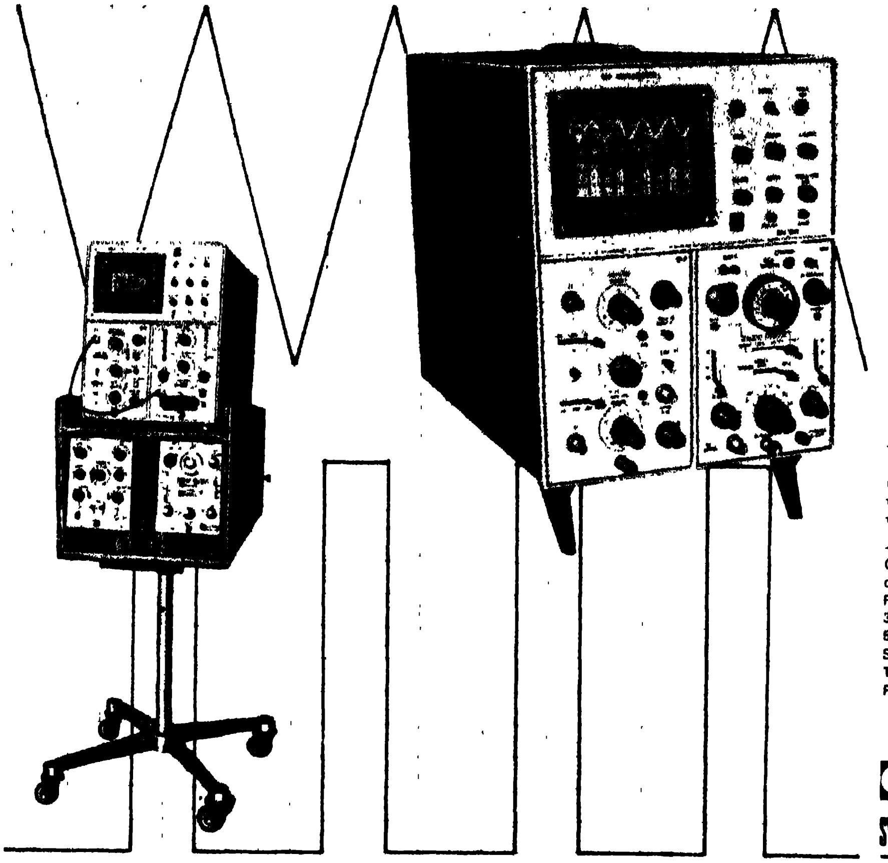

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Versatile laser printer for 5800 office system

Siemens recently presented a number of interesting innovations in the office system sector at the Hanover Fair CeBIT 86. Of particular interest was the 5834 desk-top laser printer and the 5822 workstation system for the 5800 office system. The new laser printer is smaller and, with its additional copying function, more versatile than previous models. The new 5822 workstation system features a 47.5cm screen with more than one million individually addressable picture elements, on which the contents of two DINA4-type pages can be represented side by side.

Versatile laser printer

The desk-top version of the 5834 laser printer is capable of printing ten pages of text or graphics per minute in a variety of typestyles, including modern, classic, titan and others [with as many as nine different sizes]. This is much faster than conventional printers for personal computer applications. The new unit has been developed like a PC printer for direct office use.

With a monthly capacity of 5000 or more pages, the 5834 laser printer is the ideal partner for the 5800 office system. In this case it serves as a departmental printer for the workstation systems. The printer is linked to the Siemens PC-D by way of the bus network. However, it can also be connected as a local printer for off-line workstation systems; it can even be used as a copier.

With its 512kB [or 768kB] main memory and 42MB fixed-disc storage, it resembles the 5835 office laser printer for centralised 5800 office system applications.

Computer installations in India

Presently there are about 17,000 to 18,000 computer installations in the country out of which about two per cent are mainframe computers, 20 per cent minicomputers and the rest microcomputers including wordprocessors, personal computers and accounting/invoicing machines.

All mainframe range of computers are imported, followed by minicomputers, about 70 per cent and microcomputers, about 10 per cent.

The five top Indian manufacturers of computers selected on the basis of production for the year 1985 are: DCM Data Products Ltd [turnover Rs 95.4 million], Electronics Corporation of India Ltd [turnover Rs 152.3 million], Hindustan Computers Ltd [turnover Rs 171.1 million], International Computer Indian Manufacture Ltd [turnover Rs 121.8 million], and Wipro Information Technology Ltd [turnover Rs 119.4 million].

The government has also initiated a number of computer courses at different levels. In addition, a number of programmes, on continuing education, in-service training, short-term courses, evening courses, teachers' training programmes and use of new techniques like computer-aided instructions, audiovisual instructions as well as the use of television network are being undertaken/planned.

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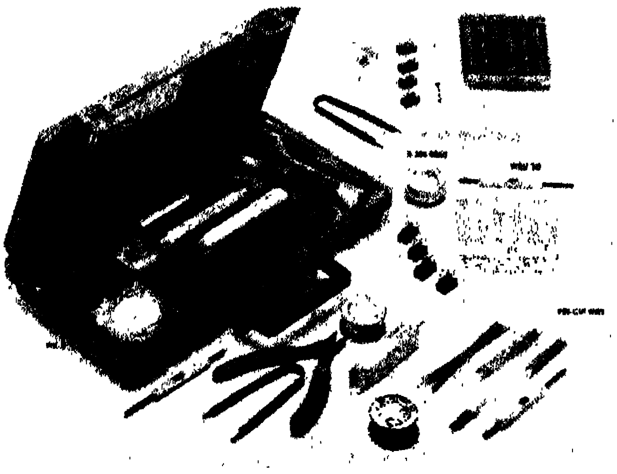

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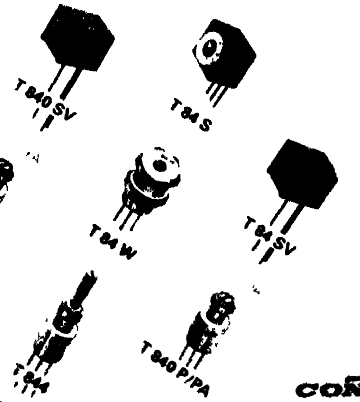

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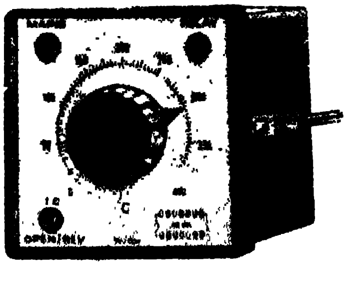

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Ajay Chikersal

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Though the BASIC program given (see box), may seem to be the heart of the project, the actual generation of pulses is achieved by a machine code routine situated in the ROM. The BASIC program handles routine duties such as accepting inputs from the keyboard and neatly displaying titles and options available.

Working

The machine code routine in the ROM was not initially meant to produce frequencies in such a range; it was designed to be used in conjunction with the Spectrum's BASIC statement 'BEEP'.

The BEEP statement has the format:

BEEP duration, pitch

where the duration and pitch represent any numerical expression. The duration is given in seconds and the pitch is given in semitones above middle 'c'.

When such an instruction is encountered during the execution of a BASIC program, the two variables (pitch and frequency) are used to set certain prerequisites to the machine language program which is subsequently 'called' to produce the desired effect.

As we would have to make repeated references to this machine language routine, we will have it known by the name 'Beeper'.

As we need a more flexible system than that provided by Uncle Clive (Sir Clive Sinclair), we will make use of the Beeper routine directly without referring to the BASIC interpreter.

The Beeper routine was however not intended for direct use by humans. Hence, before calling this routine we would have to preset certain conditions which depend upon the frequency and duration.

So, by now it should be quite clear that the role of the BASIC program would be to:

(a) Accept inputs from the user;
(b) Set the prerequisites to the Beeper; and
(c) Call the Beeper routine.

The prerequisites required for the Beeper program are in

Program Listing

```
10   REM ************************
20   REM *******SPECTRUM*********
30   REM ***SIGNAL GENERATOR****
40   REM *                      *
50   REM **AJAY CHIKFRSAL 1986**
60   REM ************************
70   REM MACHINE CODE IS STORED FROM ADDRESS-32000
80   CLEAR 31999
90   FOR T=32000 TO 32009
95   READ A
100  POKE T,A
110  NEXT T
120  REM DATA FOR MACHINE CODE PROGRAM FOLLOWS
130  DATA 33,0,0,17,0,0,205,181,3,201
135  CLS
140  BORDER 1: PAPER 7 : INK 1
150  PRINT AT 2,12;"SPECTRUM"
160  PRINT AT 3,12;"████████"
170  PRINT AT 6,8;"SIGNAL GENERATOR"
180  PRINT AT 7,8;"████████████████"
190  PRINT AT 15,0;"ENTER THE FREQUENCY
200  INPUT F
210  IF F)=10 AND F(=10000 THEN GOTO 250
220  PRINT AT 15,0;FLASH 1;"FREQUENCY RANGE IS 10-10000Hz"
230  FOR Y=1 TO 300
240  NEXT Y
245  GOTO 190
250  PRINT AT 15,20;F;" Hz"
260  PRINT AT 19,0;"ENTER THE NUMBER OF CYCLES REQD."
270  INPUT N
280  IF N)=1 AND N(=65535 THEN GOTO 320
290  PRINT AT 19,0;FLASH 1;"No. OF CYCLES RANGE IS 1-65535 "
300  FOR Y=1 TO 300
310  NEXT Y
315  GOTO 26
320  PRINT A  20,12;N
330  FOR Y=1 TO 300:NEXT Y
340  REM THE VALUES OF HL AND DE ARE COMPUTED
360  LET DE
370  LET HL=(437500/F)-30.125
375  REM DE    BROKEN INTO HIGH AND LOW PARTS
380  LET D1=INT(DE/256)
390  LET D2=DE-256*INT(DE /256)
395  REM THE VALUE OF DE IS STORED IN MEMORY
400  POKE 32005,D1
410  POKE 32004,D2
415  REM HL IS BROKEN INTO HIGH AND LOW PARTS
420  LET H1=INT(HL/256)
430  LET H2=HL-256*INT(HL /256)
435  REM THE VALUE OF HL IS STORED IN MEMORY
440  POKE 32002, H1
450  POKE 32001, H2
460  CLS
470  PRINT AT 2,12;"SPECTRUM"
480  PRINT AT 3,12;"████████"
490  PRINT AT 6,8;"SIGNAL GENERATOR"
500  PRINT AT 7,8;
510  PRINT AT 10,7 "FREQUENCY=";F;" Hz"
520  PRINT AT 12,7 "DURATION=";N/F;" SECONDS"
530  PRINT AT 14,7 "No.OF CYCLES ";N
540  PRINT AT 16,3 FLASH 1;"SQUARE WAVE SIGNAL OUTPUT
550  RANDOMIZE USR
560  PRINT AT 16,3
570  PRINT AT 17,3 "PRESS-R TO RESTART"
580  PRINT AT 19,9 "E TO EXIT"
590  IF INKEY$="E" THEN STOP
600  IF INKEY$="R" THEN GOTO 135
610  GOTO 590
```

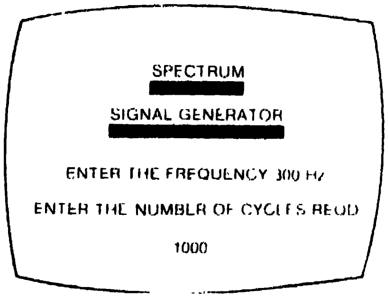
fact values which must be assigned to two double pair registers. These values are obtained by mathematical formulae which contain the variables' frequency and duration.

For the benefit of those readers who are not familiar with machine language, a detailed explanation of the entire concept is given so that this technique can be incorporated in other programs or applications.

The term 'machine language' refers to a low-level language which is native to the computer. In the Spectrum we have a Z80 microprocessor and hence the use of Z80 machine language is required whenever we want to communicate with the computer in its native tongue.

Machine language, like any other programming language, uses 'variables' which can be assigned different values. Registers can also be thought of as variables. There are many registers in Z80 assembly language, the most commonly used being A, B, C, D, E, H and L.

Each of these registers can hold any one number (one byte) between 0 and 255, inclusive of both. Since in practice we cannot restrain ourselves to such small numbers, two registers may be combined to collectively represent larger numbers. These combinations are strictly given by the pairs BC, DE and HL. We will be concerned only with the values of HL and DE as these should be set before 'calling' the Beeper routine.



SPECTRUM

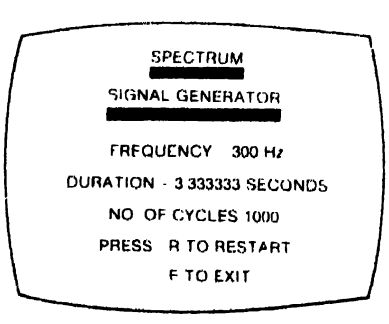
SIGNAL GENERATOR

ENTER THE FREQUENCY 300 Hz

ENTER THE NUMBER OF CYCLES REQD

1000

Fig. 1(a): The initial parameters and sample values.



SPECTRUM

SIGNAL GENERATOR

FREQUENCY 300 Hz

DURATION - 3.333333 SECONDS

NO OF CYCLES 1000

PRESS R TO RESTART

E TO EXIT

Fig. 1(b): Display of initial parameters while output of the signal is available through the 'EAR' socket.

When we couple two single registers to form a double register, we can handle numbers between 0 and 65535, i.e. a total of 65536 numbers (256 × 256 = 65536).

The formulae which relate HL and DE to the frequency and duration are:

For register pair HL:

HL = (437500/Frequency) - 30.125

and for register pair DE:

DE = Frequency × Duration

As the time period 'T' is given as

t = 1/F,

Duration Time period × Number of cycles

- Number of cycles/Frequency

Rearranging the above, we obtain

Duration × Frequency = Number of cycles

where the duration is in seconds and the frequency in hertz.

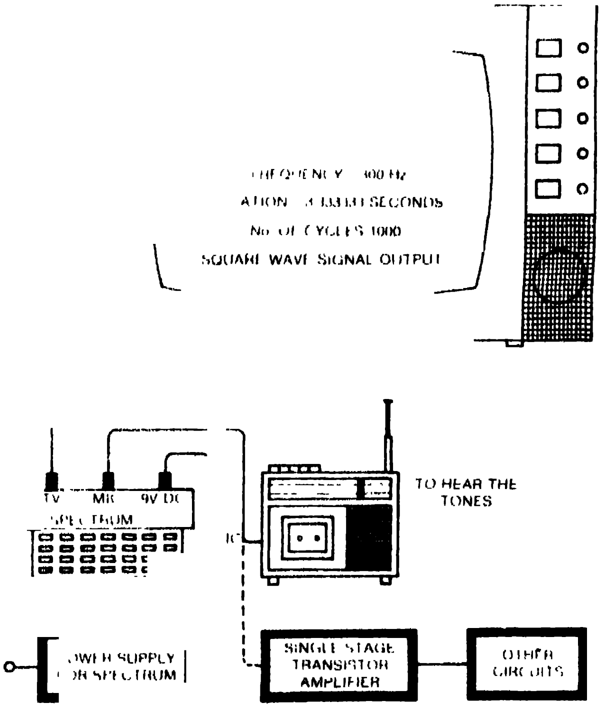


Fig. 2: Applications and final set up.

Thus, DE represents the number of cycles that will be produced. This can be specified between 1 and 65535, including both.

Let us now calculate the theoretical upper and lower limits of the frequency which depend upon the minimum and maximum values of HL. As seen already, HL is a register pair, i.e. it can hold any number between 0 and 65535.

Rearranging the equation for HL, to represent frequency in terms of HL, we obtain

Frequency = 437500/(HL+30.125)

For a minimum value, HL=0, we have

Frequency = 437500/30.125

= 14522.8 Hz

For a maximum value, HL=65535, we get

Frequency = 437500/(65535+30.125)

= 6.67 Hz

Though these are the theoretical limits of the frequency, the 10Hz to 10kHz range would be a more accurate and practical one. The square waves produced in this range have a typical rise time of less than 1 microsecond.

An example

Let's consider a practical example. Suppose, it is required to produce a frequency of 500 Hz for a duration of six seconds:

DE = Frequency × Duration

= 500 × 6

= 3000

HL = (437500/Frequency) 30.125

= (437500/500)-30.125

= 844.875

Always **round down** the value of HL obtained in the step above, so that

HL=844

Having set these two registers, we can call the Beeper routine to produce the square-wave signal.

The values of HL and DE are set automatically by the BASIC program which utilises the same formulae to compute the values and utilises the POKE statement to store the values in memory.

The analogy of my small machine language routine with BASIC is given in the Table below. This routine only acts as a link between the BASIC program and the ROM routine (Beeper).

TABLE

Analogy of the Machine Language with BASIC

Address	Hex Dump	Z80 Assembler	Analogous BASIC Program
32000	21 00 00	LD HL,0 (see text)	LET HL=0
32003	11 00 00	LD DE,0 (see text)	LET DE=0
32006	CD B5 03	CALL 949d (BEEPER)	GOSUB BEEPER (Address 949d)
32009	C9	RET	RETURN

Here's a brief summary of the BASIC program for your understanding:

Line 80 reserves memory to store the small machine code program beginning at address 32000.

Lines 90-110 store the machine code into memory, the code is transferred from the DATA statement in line 130 to the memory address from 32000 to 32009.

Lines 150-290 display the title and accept the input from the user making sure that the inputs are within the range.

Lines 360 and 370 compute the values of registers HL and DE.

Lines 380-450 break the values of HL and DE in HIGH and LOW parts for their subsequent storage in memory.

Lines 490-540 display the initial parameters set by the user, including a flashing indication when the signal is available.

Fig. 2 shows how the sound from Spectrum can be amplified to hear the tones being generated. The output from its MIC socket can also be fed to a single-stage transistor amplifier for use of these signals in other circuits. □

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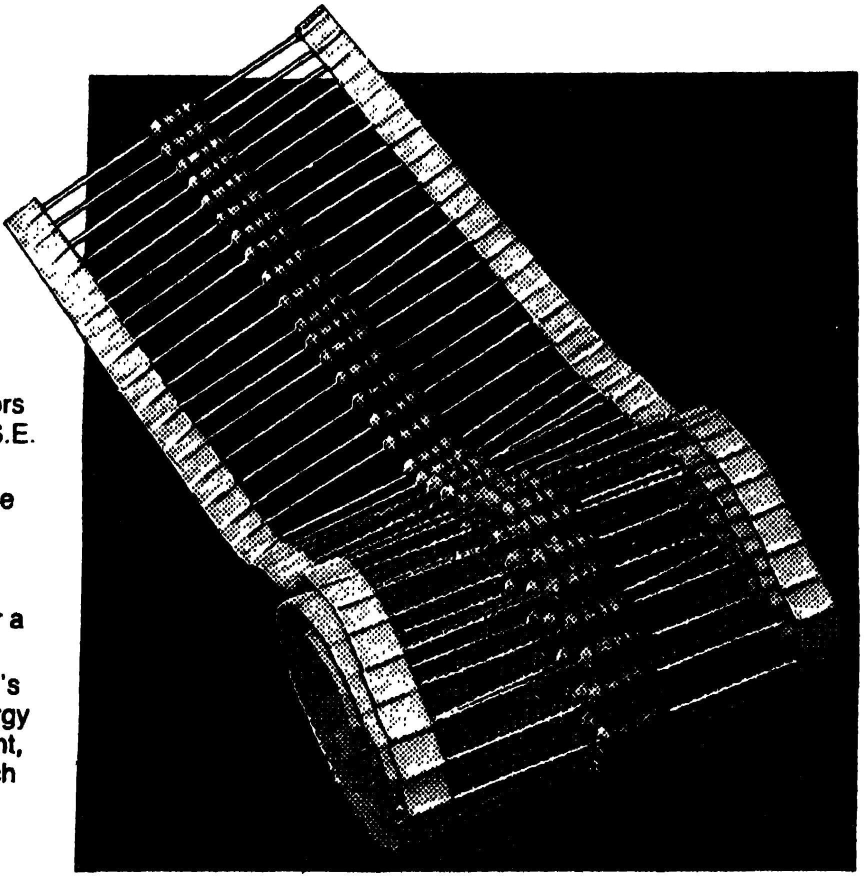

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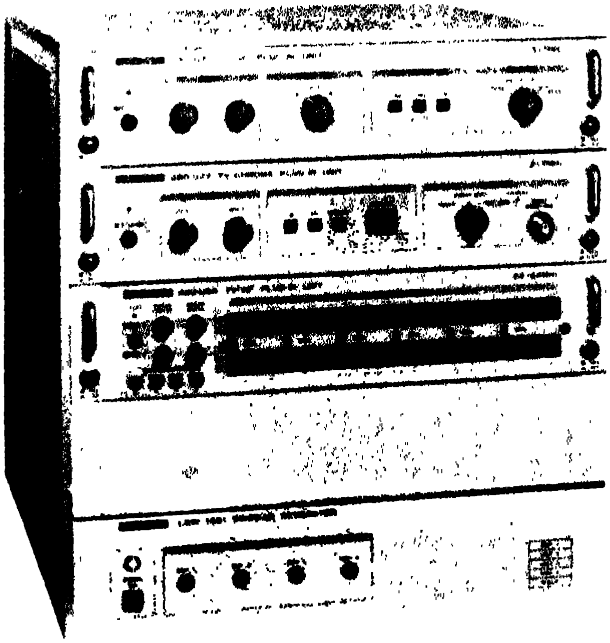

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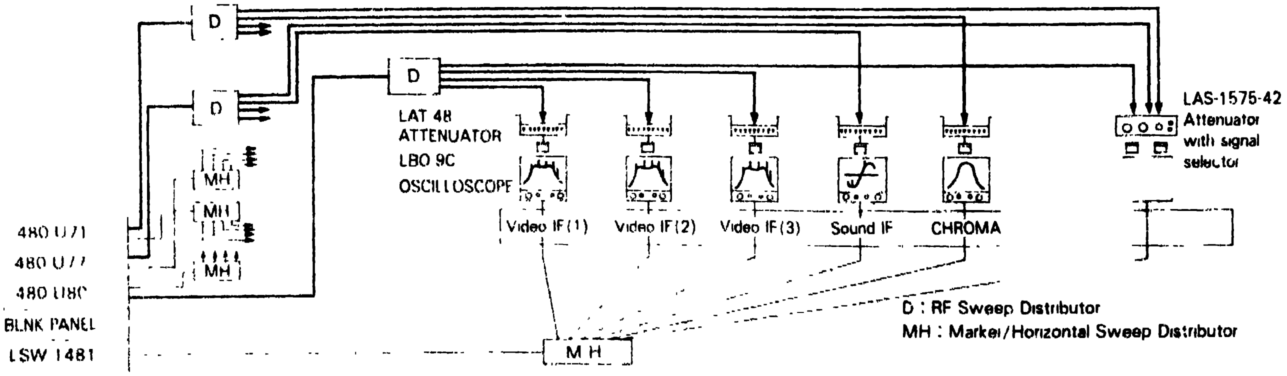

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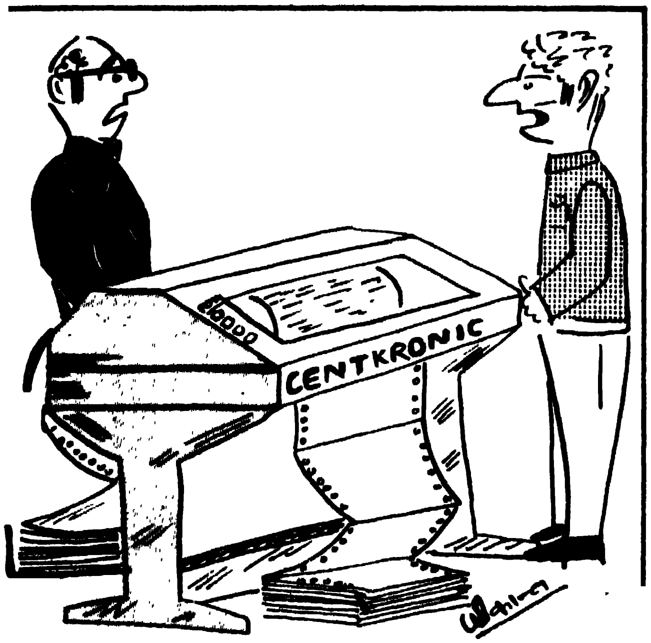

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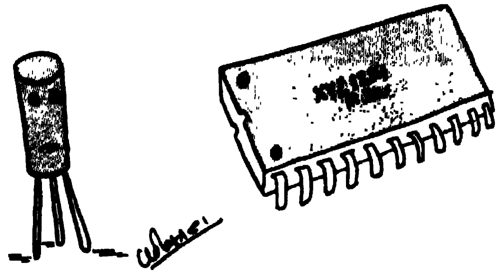

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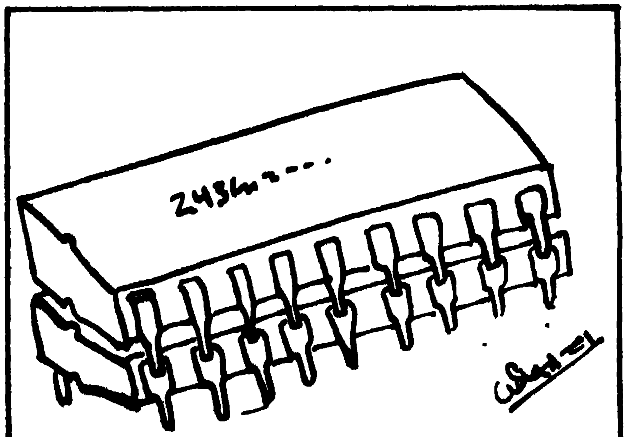

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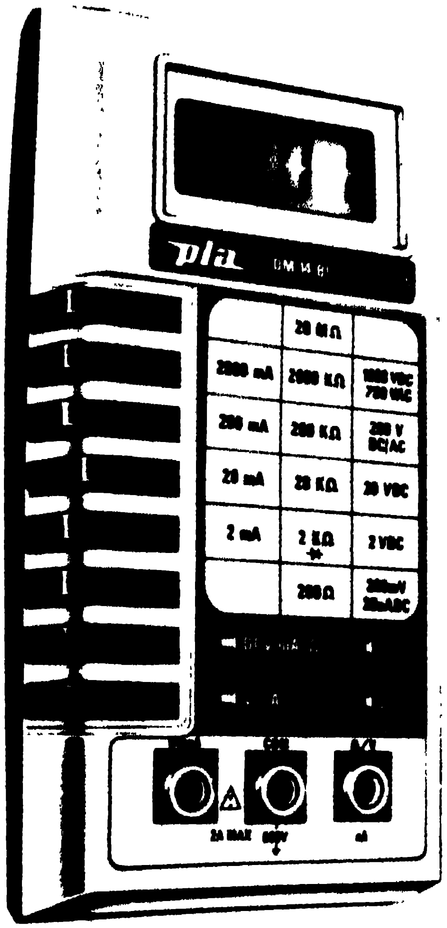

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An Introduction to Compilers

Part I

Suresh K. Basandra

The subject matter of compiler construction can be considered as a form of language translation. The phrase 'language translation' suggests the existence of several languages and, also, the notion of translation. By translation we mean a mapping of sentences of a given language to sentences of another given language.

A necessary aspect of translation is that the mapping preserves the meaning of the sentence to be translated. Since this is a very broad constraint, it should be evident that, in general, translation is a one-to-many mapping.

As we are interested in solving problems by using computers, the act of translation can be imperatively expressed as: Take an arbitrary sentence of some given language, analyse it and, if possible, synthesise a sentence of another given language so that it completely conveys the meaning of the initial sentence.

To realise this, however, several major problems have to be carefully considered: What is a language? What do we mean by an analysis of statements in a language? How do we ascribe a meaning to a sentence in any language? In any given language, how do we synthesise sentences which will have a given meaning? If many sentences can be ascribed the same meaning, how do we choose amongst them?

The most common languages we know of are the natural languages such as English. Our understanding of such languages is rather loose and cannot be succinctly expressed. This is not at all surprising, for such languages are usually very vast. Consequently, the problem of translation between such languages has mammoth proportions. Fortunately, for the present, our interests lie in a very specific set of languages, the so-called 'programming languages'.

Programming languages provide a precise and unambiguous means for communication between man and machine. Amongst such languages, we distinguish between those which are more suited for problem-solving by man from those which are suited for direct interpretation by a machine. In this article, we will be concerned with the translators (agents which perform translation) which translate sentences from languages in the former class to sentences of languages in the latter class. Compilers are such translators.

Compilers and translators

A 'translator' is a program that takes as input a program written in one programming language (the source language) and produces as output a program in another language (the object or target language). If the source language is a high-level language such as FORTRAN, PL/I or COBOL, and the object language is a low-level language such as an assembly language or machine language, then such a translator is called a 'compiler'.

Programs written in source languages are called 'source programs'. On the other hand, object languages are usually suited for machine interpretation. Programs expressed in object languages are called 'object programs'. To translate a source program, the compiler must analyse it thoroughly and synthesise an equivalent object program.

The task performed by a compiler is called 'compilation'. During compilation, the process of source program analysis yields a variety of information about source programs. This information has to be preserved by the compiler for it to produce an equivalent object program. Various data structures, such as tables, lists, trees, etc are employed by the compiler to preserve this information. The construction of an equivalent object program is directed by the information

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Mr Basandra, an M. Tech in Computer Technology, unravels the system of 'compilers' and various other terms like 'translators' and 'interpreters' that the readers may have heard and wondered as to their actual meaning.

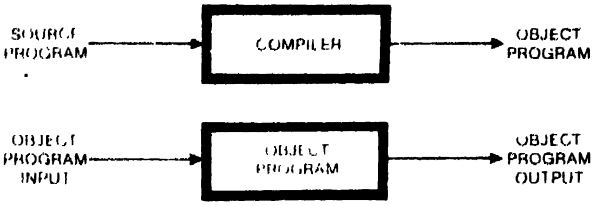

Fig. 1: Compilation and execution.

preserved in these data structures. All the actions performed by a compiler are said to occur at 'compile-time'.

Executing a program written in a high-level programming language is basically a two-step process, as illustrated in Fig. 1. The source program must first be compiled, i.e. translated into the object program. Then the resulting object program is loaded into memory and executed.

Other translators

Certain translators transform a programming language into a simplified language, called 'intermediate code', which can be directly executed using a program called an 'interpreter'. We may think of the intermediate code as the machine language of an abstract computer designed to execute the source code. For example, SNOBOL is often interpreted, the intermediate code being a language called 'polish postfix notation'.

In some cases, the source language itself can be the intermediate language. For example, most 'command languages', such as JCL, in which one communicates directly with the operating system, are interpreted with no prior translation at all.

Interpreters are often smaller than compilers and facilitate the implementation of complex programming language constructs. However, the main disadvantage of interpreters is that the execution time of an interpreted program is usually more than that of a corresponding compiled object program.

There are several other important types of translators, besides compilers. If the source language is assembly language and the target language is machine language, then the translator is called an 'assembler'.

The term 'preprocessor' is sometimes used for translators that take programs in a high-level language into equivalent programs in another high-level language. For example, there are many FORTRAN preprocessors that map 'structured' versions of FORTRAN into conventional FORTRAN.

Programming languages

Here it is intended to define a programming language formally. This has to be done because, intuitively speaking, a compiler specifies a relationship between source programs and object programs. It does this for all source programs, and hence compilation is really a relationship between two languages. In other words, a compiler is not concerned with any specific set of source programs but all programs that can be written in the source language.

A programming language is a notation with which people can communicate algorithms to computers and to one another.

Syntax

A program in any language can be viewed as a string of characters chosen from some set, or 'alphabet', of characters. But how do we prescribe which strings of characters represent valid programs? The rules that tell us whether a string is a valid program or not are called the 'syntax' of the language.

It is often almost impossible to state concisely and precisely what strings are valid programs, just as it is hard to state which sentences of English are proper and which are not.

Semantics

Once we know that we have a valid program, how do we specify what the program does? It is essential to know what a program means if we are to compile it faithfully into a machine language program that does what the programmer expects. The rules that give meaning to programs are called the 'semantics' of the programming language.

The semantics of a programming language are much harder to specify than its syntax. No completely satisfactory means for specifying semantics in a way that helps construct a correct compiler for the language has been found.

The hierarchical structure of programming languages

A programming language is a notation for specifying a sequence of operations to be carried out on data objects. Both the data objects and the operations can be grouped into a hierarchy that looks like the tree of Fig. 2. Not all languages have every one of these features, and some languages such as ALGOL 68, permit statements to be in expressions. Nevertheless, the units in this hierarchy are so common that they should be familiar to all.

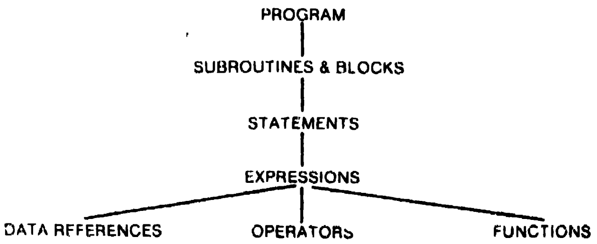

Fig. 2: Hierarchy of program elements.

At the top of the hierarchy is the program itself. The program is the basic execution unit. Next comes an entity that can be compiled but not necessarily executed—the subroutine or block. These are units which may have their own data (local names).

Subroutines differ from blocks by being callable from other portions of a program. Both subroutines and blocks are composed of statements. In turn, statements are fashioned from expressions which are made up of operators, function calls, and references to data.

The structure of a compiler

The compiler takes as input a source program and produces as output an equivalent sequence of machine instructions. This process is so complex that it is not reasonable, either from a logical point of view or from an implementation point of view, to consider the compilation process as occurring in one single step. For this reason, it is customary to partition the compilation process into a series of subprocesses called 'phases' as shown in Fig. 3. A phase is a logically cohesive operation that takes as input one representation of the source program and produces as output another representation.

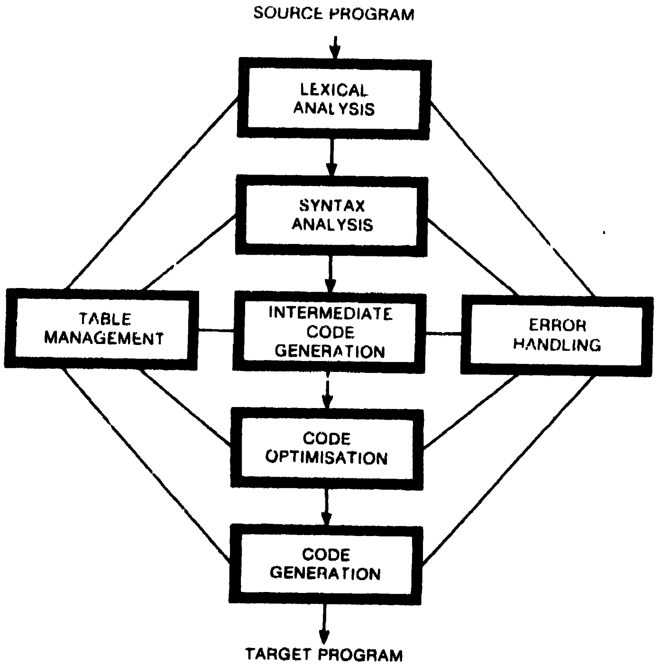

Fig. 3: Phases of a compiler.

As input to a compiler, the source program is only a string of characters. From this linear representation of the program, the process of source program analysis should detect the structure and meaning of the program.

This is very similar to the actions involved in finding constituent phrases in a sentence in English, in which case we do so by making use of the English grammar. In order to understand an English sentence, we must first know the meaning of various words used in it; grouping the words into phrases allows us to ascribe meanings to these phrases; and finally, combining the meanings of the phrases according to the grammatical structure of the sentence leads to an understanding of the sentence.

From the above analogy, it is reasonable to assume that the source language has a grammar which defines acceptable grammatical structures for source programs. In order to analyse the structure of a source program, we have to formulate a strategy for recognising its constituent sub-structures. Also, we have to detect the methods by means of which these sub-structures are bound together to form a whole source program.

Looking at the analogy of grammatical analysis of English sentences again, we note that we recognise words first and then we search for the phrases. The first phase consists of the analysis of the string of characters in the source program so as to form meaningful primitives (analogous to words and punctuation marks in an English sentence).

The first phase, called the 'lexical analyser' or 'scanner' separates characters of the source language into groups that logically belong together; these groups are called 'lexemes' or 'tokens'. The usual tokens are keywords such as DO or IF, identifiers (the equivalent of 'names' in programming languages) such as X or NUM, operator symbols such as '·-', ' ', '=' or '+', and punctuation symbols such as parentheses or commas.

The output of the lexical analyser is a stream of tokens which is passed to the next phase. The tokens in this stream can be represented by codes which we may regard as integers. Thus, DO might be represented by 1, + by 2, and 'identifier' by 3. In the case of a token like identifier, a second quantity that indicates which of those identifiers used by the program is represented by this instance of token identifier is passed along with the integer code for identifier.

The task of this first phase is quite simple and straightforward. Subsequent to this phase of analysis, a source program may be viewed as a sequence of tokens.

Following lexical analysis is the task of recognising grammatical phrases in a source program. This is a more complicated task: sequences of lexemes have to be grouped together to form simple phrases of the source language; these simple phrases are used to form more complex ones and, ultimately, source programs.

All these actions are the substance of 'syntax analysis', the term usually ascribed to this second phase in the analysis of source programs. The syntax analyser groups tokens together into syntactic structures. For example, the three tokens representing A+B might be grouped into a syntactic structure called an 'expression'. Expressions might further be combined to form statements.

Often, the syntactic structure can be regarded as a tree whose leaves are the tokens. The interior nodes of the tree represent strings of tokens that logically belong together.

The 'intermediate code generator' uses the structure produced by the syntax analyser to create a stream of simple instructions. Many styles of intermediate codes are possible. One common style uses instructions with one operator and a small number of operands. These instructions can be viewed as simple macros. The primary difference between intermediate code and assembly code is that the intermediate code need not specify the registers to be used for each operation.

'Code optimisation' is an optional phase designed to improve the intermediate code so that the ultimate object program runs faster and/or takes less space. Its output is another intermediate code program that does the same job as the original, but perhaps in a way that saves time and/or space.

The final phase, known as 'code generation', produces the object code by deciding on the memory locations for data, selecting codes to access each datum, and selecting the registers in which each computation is to be done. Designing a code generator that produces truly efficient object programs is one of the most difficult parts of compiler design, both practically and theoretically.

The 'table-management' or 'book-keeping' portion of the compiler keeps track of the names used by the program and records essential information about each, such as its type (integer, real etc). The data structure used to record this information is called a 'symbol table'.

The 'error handler' is invoked when a flow in the source program is detected. It must warn the programmer by issuing a diagnostic, and adjust the information being passed from phase to phase so that each phase can proceed.

It is desirable that compilation be completed on flawed programs, at least through the syntax-analysis phase, so that as many errors as possible can be detected in one compilation. Both the table-management and error handling routines interact with all phases of the compiler.

Passes

In an implementation of a compiler, portions of one or more phases are combined into a module called a 'pass' A pass reads the source program or the output of the previous pass, makes the transformation specified by its phases, and writes output into an intermediate file which may then be read by a subsequent pass. If several phases are grouped into one pass, then the operation of the phases may be interleaved, with control alternating among several phases.

The number of passes, and the grouping of phases into passes, are usually dictated by a variety of considerations germane to a particular language and machine rather than by any mathematical optimality criterion. The structure of the source language has a strong effect on the number of passes.

Certain languages require at least two passes to generate code easily. For example, languages such as PL/1 or ALGOL 68 allow the declaration of a name to occur after uses of that name Code for expressions containing such a name cannot be generated conveniently until the declaration has been seen.

The environment in which the compiler must operate can also affect the number of passes. A multi-pass compiler can be made to use less space than a single-pass compiler, since the space occupied by the compiler program for one pass can be reused by the following pass.

A multi-pass compiler is, of course, slower than a single-pass compiler, because each pass reads and writes an intermediate file. Thus, compilers running on computers with small memory would normally use several passes while, on a computer with a large random access memory, a compiler with fewer passes would be possible.

Reducing the number of passes

Since each phase is a transformation on a stream of data representing an intermediate form of the source program, it may be wondered how several phases can be combined into one pass without the reading and writing of intermediate files. In some cases one pass produces its output with little or no memory of prior inputs. Lexical analysis is typical. In this situation, a small buffer serves as the interface between passes. In other cases, we may merge phases into one pass by means of a technique known as 'backpatching'. In general terms, if the output of a phase cannot be determined without looking at the remainder of the phase's input, the phase can generate output with 'slots' which can be filled in later, after more of the input is read.

While it is not possible to deal with backpatching in detail, an example from assemblers will serve as a paradigm. An assembler might have a statement like

```
GOTO    L
```

which precedes a statement with label L. A two-pass assembler uses its first pass to enter into its symbol table a list of all identifiers (statement labels and data names) together with the machine address (relative to the beginning of the program), to which these identifiers correspond. Then a second pass replaces mnemonic operation codes, such as GOTO by their machine language equivalent, and replaces uses of identifiers by their machine address.

A one-pass assembler, on the other hand, could generate a skeleton of the GOTO machine instruction the first time it saw GOTO L. It could then append the machine address for this instruction to a list of instructions to be backpatched once the machine address for L is determined. For example, when the assembler encounters a statement such as

```
L:ADD  X
```

it scans the list of statements referring to L and places the machine address for statement L : ADD X in the address field of each such instruction. Subsequent assembly instructions referring to L can have the value for L substituted immediately.

In a compiler, most of the backpatching that needs to be done is done over relatively short distances. Labels, for example normally need to be backpatched as above only with one procedure or subroutine. The distance over which backpatching occurs is important since the code to be backpatched must remain accessible until backpatching is complete. Even though the object program may fit in memory when it is produced, intermediate forms of the source program may be too big to fit in memory all at once, especially as a substantial portion of memory may be occupied by the compiler program itself. **(To be continued)**

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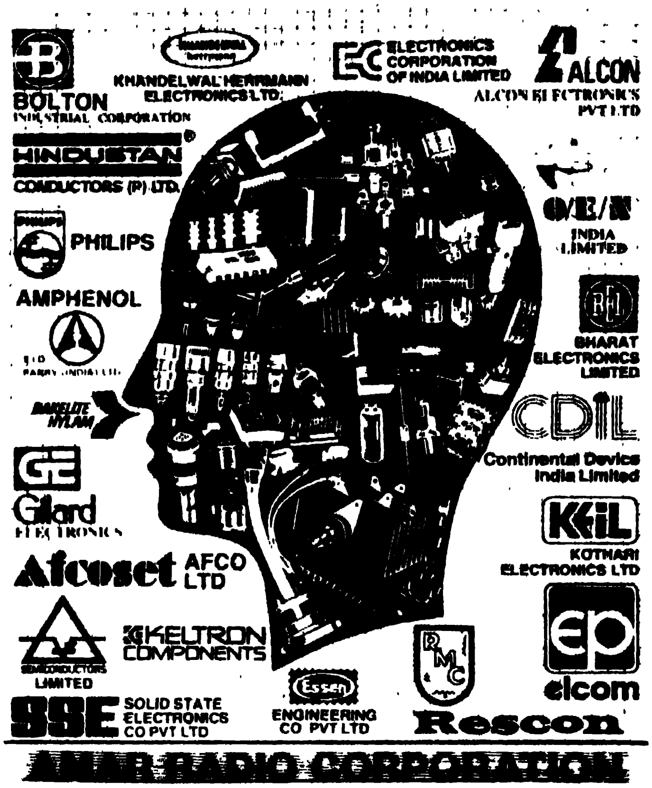

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Comparative Study of Computer Languages

Input Output Statements(4)

Part XIII

R. Ramaswamy

As in the case of FORTRAN, COBOL, BASIC and PL/1, we also have three ways of entering data into a PASCAL program. These are:

1. Entering data through the console.
2. Entering data in the program itself.
3. Entering data in the program by reading a file.

Here we will consider the first two methods and study the third later.

Input statements for entering data through the console

There are two input statements, namely, READ and READLN. The READ statement gets the data given in a stream fashion, while the READLN statement gets the data given on a line by line basis. The general form of the READ statement is

```
READ(list);
```

And the general form of the READLN statement is

```
READLN(list);
```

Suppose we write the READ statement as follows:

```
READ(A,B);
READ(C,D);
```

In the above case the values of A, B, C and D can be keyed in one line or two lines or three lines or even four lines, as shown below

```
34.5 65.7 78.9 87.0          (One line)

34.5 65.7    }
78.9 87.0    }               (Two lines)

34.5 65.7    }
78.9         }               (Three lines)
87.0         }

34.5         }
65.7         }
78.9         }               (Four lines)
87.0         }
```

The first READ statement reads the first two values in the stream. The second READ statement reads the next two values in the stream irrespective of the number of data in each line.

Suppose we give READLN statements as shown below:

```
READLN(A,B);
READLN(C,D);
```

In the above case the values of A and B must be keyed in the first line and the values of C and D must be keyed in the second line. If the values of all the variables are keyed in the same line, the computer will give error message. Both the READ and the READLN statements give instructions to the computer to get the data for the program through the console. The READ and the READLN statements in PASCAL are analogous to the READ statement in FORTRAN, INPUT statement in BASIC, ACCEPT statement in COBOL and GET LIST statement in PL/1.]

Output statements for printing the result on paper

There are two output statements to print the result on paper. They are the WRITE and the WRITELN statements. The general form of the WRITE and the WRITELN statements are

```
WRITE(list),
WRITELN(list);
```

The WRITE statement will cause the printing of the values of the variables in the list continuously. If the first line is full the printing will be continued in the second line until the list is exhausted. The WRITELN statement will cause the printing of the values of the variables in the first line. If there are more variables than could be accommodated in the first line, the same will not be printed. Suppose one writes

```
WRITE(A,B),
WRITE(C,D);
```

The values of A, B, C and D will be printed in the same line.

Now if one writes

```
WRITELN(A,B);
WRITELN(C,D),
```

the values of A and B will be printed in the first line and the values of C and D will be printed in the second line. A string in the WRITE or the WRITELN statement will be printed as it is. Numeric quantities will be printed in the exponent notation. Suppose the basic pay of a person is 2500.00 and if one writes a statement

```
WRITELN ('BASICPAY=', BASICPAY),
```

the computer will print the result as

```
BASIC PAY = 2.500000E+03
```

Obviously, the above form is not meaningful. The numeric value must be given in floating point notation. For this purpose we have to give formats for the output.

Formatting the output

When we give a simple WRITE statement or a WRITELN statement with the arguments list inside the parantheses, the computer will print the result in a pre-defined format. But when we want to print the result as per our layout, we have to give necessary specifications explicitly. Such specifications are called format specifications. The field width for each variable can be specified as an integer constant or an expression yielding an integer value immediately after the variable followed by a colon mark. Numbers as well as characters will be printed right justified in the given field. For example, if one writes

```
WRITELN(A:10);
```

and the value of A is 46, the value will be printed in the ninth and the tenth columns, leaving the preceding eight columns blank. If A has been defined as a character variable whose value is 'K', then the letter K will be printed in the tenth column leaving the preceding nine columns blank. If A had been defined as a BOOLEAN variable whose value is TRUE, then the value TRUE will be printed in the columns 7 to 10, leaving the first six columns blank.

The point is that the printing is done always right justified in the given field width, whether the value is a number or a character or a logical constant. If the value of A is 56.78, we can give a specification to print the two digits to the right of the decimal point within a total field width of 10 as follows:

```
WRITELN(A 10 2);
```

The number will be printed in the right justified position in the field width of 10 as

```
bbbbb56 78
```

If you have more than one variable in the WRITELN list, the field specification is given separately for each of the variables. For example, one can write

```
WRITELN (A 10.2, B.7.3, C.5),
```

In the above case, A will be printed right justified in the first ten columns, B will be printed right justified in the second seven columns and C will be printed right justified in the third five columns. There are no other formatting specifications in PASCAL. We find that formatting is the simplest in PASCAL as compared to other languages.

A WRITELN statement without any argument list simply causes the computer to skip to the next line and this is used for giving vertical spacing between lines.

Input statements for entering data in the program

The READ and the READLN statements require the data to be entered through the console. PASCAL has another provision to initialise the data in the program itself. This is done by a declaration statement called the CONSTANT declaration statement. Its general form is as follows:

```
CONST      variable-1 = value;
           variable-2 = value;
           variable-3 = value;
                       ....;
                       .. .;
```

The value associated with the identifier is given as an equation. The value of the identifier must not change in the program by any statement. This means that the variable whose value is declared to be a constant must not change during the program execution.

The reserved word CONST must appear only once, though the values of any number of variables can be defined. The constant values assigned may be either numeric or character or Boolean or even a string. Constant declarations must be made ahead of the program. The following are examples of valid CONSTANT declarations:

```
CONST     PI = 3.14159;
          TWO = 2;
          BLANK = ' ';
          ALWAYS = TRUE;
          EMPNAME = 'BALACHANDRAN';
          ALPHA = 'A'
```

At the end of the value the punctuation semicolon is a must. In PASCAL, the variables which have been initialised under CONSTANT declaration must not occur on the left-hand side of any assignment statement within the program. This means that these variables cannot be assigned any other value in that particular program. This statement can be used only when constant values are to be initialised and not when changing data values are to be initialised.

Summary of the input statements

Language	General form of statements for entering data through console	General form of statements for entering data in the program
FORTRAN	READ(m,n) list	DATA list/values/
COBOL	ACCEPT variable	77 variable PIC .. VALUE ...
BASIC	INPUT list	READ list
PL/I	GET LIST(list);	DCL(list) (type STATIC INIT (values),
PASCAL	READ(list), READLN(list)	CONST variable = value; (only for constant data values)

Thus, we see that all the languages provide facilities for entering data into the program either through the console or entering the data in the program itself. The way of coding the statements are different in the different languages.

Summary of the output statements

Language	General form of output statements for printing the result on paper	Remarks about formats
FORTRAN	WRITE(m,n) list	A separate format statement must be given
COBOL	DISPLAY list	Formats must be given separately
BASIC	PRINT list PRINT USING formats or format variable; list	Formats can be given either in the PRINT statement or separately
PL/I	PUT LIST(list); PUT EDIT(list) (formats or R (format label));	Formats can be given either in the PUT LIST statement or separately
PASCAL	WRITE(list); WRITELN(list);	Formats must be given in the WRITE or the WRITELN statement

This form of output statements will print the result on paper and also display the result on the screen.

Self-testing assignment

You have two variables A and B whose values are 23.7 and 44 respectively. Write the input and the output statements in the proper sequence: (a) to enter the data through and console and print them on paper, and (b) to enter the data in the program itself and print them on paper in all the five languages. Give formats wherever necessary.

FORTRAN

```
 Inputting through console        Inputting through the program
 and outputting on paper          and outputting on paper

      INTEGER B                        INTEGER B
      READ(1,10) A,B                   DATA A,B/23.7,44/
 10   FORMAT(F5.1, I3)                 WRITE(2,12)A,B
      WRITE(2,12)A,B              12   FORMAT (1X,F5.1,I5)
 12   FORMAT(1X,F5.1,I5)
```

COBOL

```
 77  A PIC 999V9.                 77  A PIC 999V9 VALUE 23.7.
 77  B PIC 999.                   77  B PIC 999 VALUE 44.
 77  C PIC ZZZ.9.                 77  C PIC ZZZ.9
 77  D PIC ZZZZZ                  77  D PIC ZZZZZ
     ACCEPT A                         MOVE A TO C.
     ACCEPT B.                        MOVE B TO D
     MOVE A TO C                      DISPLAY C, D
     MOVE B TO D.
     DISPLAY C, D
```

BASIC

```
 INPUT A, B                      READ A, B
 PRINT USING "### # ####";       DATA 23.7, 44
  A,B                            PRINT USING "###.# ####",
                                  A,B
```

PL/1

```
 DCL A FLOAT BINARY,             DCL A FLOAT BINARY
       B FIXED BINARY;            STATIC INIT (23.7),
 GET LIST (A, B),                 B FIXED BINARY
 PUT SKIP EDIT(A, B)              STATIC INIT(44);
  (F(5,1),F(5));                 PUT SKIP EDIT(A,B)
                                  (F(5,1),F(5));
```

PASCAL

```
 VAR A. REAL; B. INTEGER;        CONST A = 23.7; B = 44;
 READLN(A,B),                    WRITELN(A:5:1, B:5);
 WRITELN(A:5:1, B:5);
```

It may be noticed that only in BASIC no declarations are made about the variable types. In FORTRAN declaration is made only for the variable B, since the type has to over-ride the predefined convention. There is no declaration for A since its value is according to the predefined convention.

In all the above cases the result will be printed in the same way as shown below:

```
23.7  44
```

What about string data items?

Only a string of maximum four characters length can be stored in a single FORTRAN variable. In PASCAL, only one character can be stored in a variable and the variable is called the character variable. Strings can be read, assigned, manipulated and printed with facility only in the three languages, COBOL, PL/1 and BASIC.

Another self-testing assignment

A string constant 'KRISHNAN' is to be stored. Write the input and the output statements in the proper sequence: (a) to enter the data through the console and print them on paper, and (b) to enter the data in the program itself and print them on paper in all the five languages. Give the declaration statements and formats wherever necessary.

FORTRAN

Inputting through console and outputting on paper — **Inputting through the program and outputting on paper**

```
   READ (1,10) A,B                 DATA A,B,'KRIS',
10 FORMAT(2A4)                     'HNAN'/
   WRITE(2,12)A,B                  WRITE(2,12) A,B
12 FORMAT(1X, 2A4)              12 FORMAT(1X, 2A4)
```

COBOL

```
77 A PIC A(8).                  77 A PIC A(8) VALUE
   ACCEPT A.                       'KRISHNAN'
   DISPLAY A.                       DISPLAY A
```

BASIC

```
INPUT A$                        READ A$
PRINT A$                        DATA "KRISHNAN"
                                PRINT A$
```

PL/1

```
DCL A CHARACTER(8);             DCL A CHARACTER(8)
GET LIST(A);                    STATIC INIT ('KRISHNAN'),
PUT LIST(A);                    PUT LIST(A);
```

PASCAL

```
VAR A,B,C,D,E,F,G,H: CHAR,   CONST A = 'KRISHNAN',
READLN(A,B,C,D,E,F,G,H);     WRITELN(A),
WRITELN(A,B,C,D,E,F,G,H).
```

In FORTRAN, we have stored the name 'KRISHNAN' in two variables A and B since one variable can read and write only four characters. The variables are read and written in the A format. There are no declaration statements for that in FORTRAN.

In COBOL there is no problem, since a variable which is declared as belonging to alphabetic data type can store long strings.

In BASIC, we have a different way of coding string variables. A dollar sign at the end of the variable indicates that it is a string variable and it can store long strings.

In PL/1, a string variable is declared as CHARACTER with its length specified in the bracket.

In PASCAL, a single variable can read and write only one character. Since the string data has eight characters, eight variables are declared. Then they are read and written. When a PASCAL variable is declared as a CONSTANT with a value, it can store a string. So we have given a CONSTANT declaration giving the value of the variable A equal to the string data. Then the constant variable is given in the WRITELN statement.

When we come to array structure for data we will see how the string data can be more efficiently handled in FORTRAN and PASCAL.

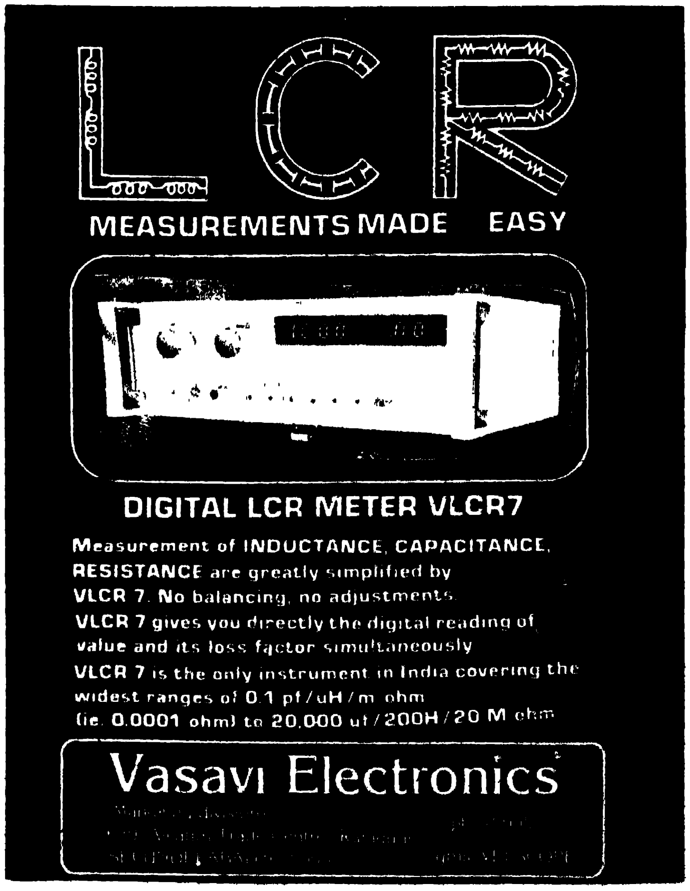
Some points to remember

The input to the computer is raw data. The output from the computer is processed data. The computer makes use of the program and converts the raw data into a meaningful data. The computer is simply a data converter and we may call it a data processing machine.

Remember that all processings are done completely automatically by using the stored instructions or the program. That is, the computer can store both the program and the data in its memory. Once it is started, it can do all the operations on the data as per the program of instructions completely automatically without any human intervention at any stage of operation and output the result.

It is this automaticity coupled with the fantastic speed that has made the computer so versatile. The computer is a superb marvel of modern technology. It is progressing by leaps and bounds, and we can expect many more marvels in the years to come. Man is constantly generating new knowledge and one has to be a learner throughout life!

(To be continued)



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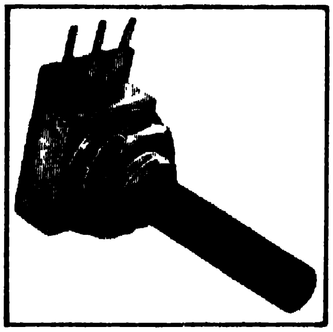

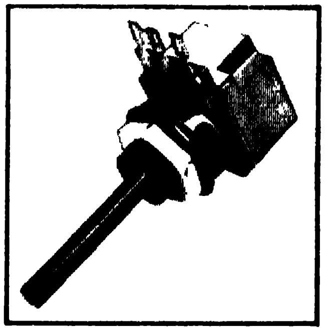

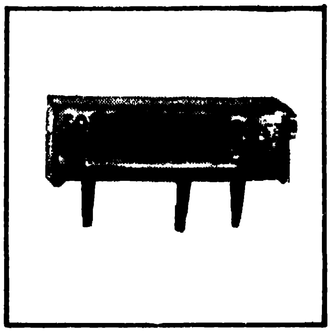

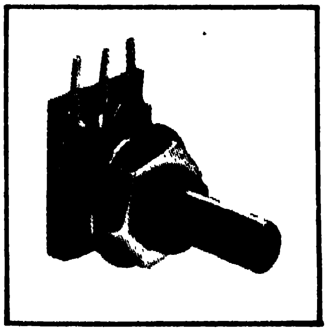

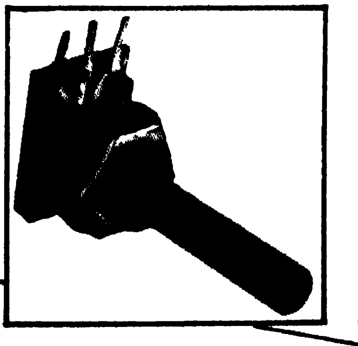

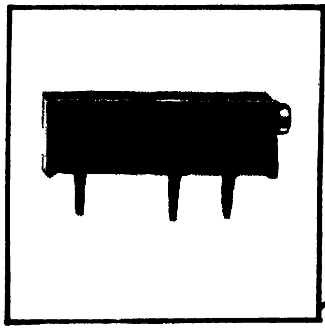

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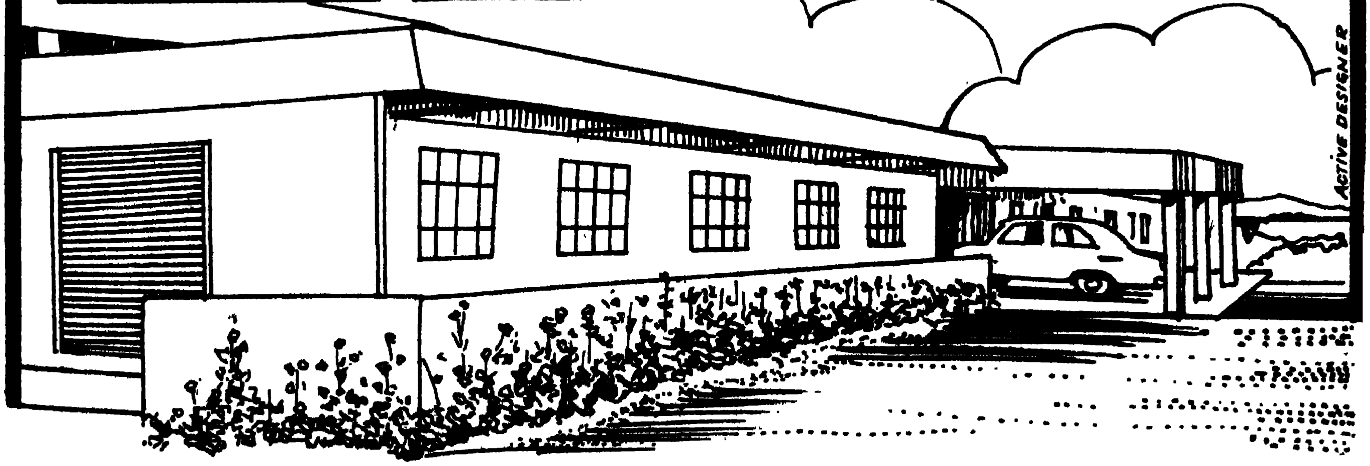

Traffic Light Control System

Ravi Kant Taxali

Traffic density on roads in big cities like Delhi, Bombay, Calcutta, Madras and Hyderabad has become so high that it requires a lot of planning for smooth flow of the traffic on the roads. Therefore, the traffic lights have been installed at almost all major traffic crossings in these cities.

Have you ever noticed the actual sequence of traffic lights at some busy crossing? Well, let us have a look at a traffic crossing and write down the sequence. Fig. 1 shows two roads -one in North-South (NS) direction and the other in East-West (EW) direction. In this figure we have not shown the lights at the South and East ends. Lights at the South and East ends are similar to lights at North and West ends respectively. So, when the traffic for South to North is open green lamp no. 3 is on, the North to South traffic will also be open. In other words, the lights at the two opposite ends are connected in parallel.

The typical sequence of lights and the duration of each step, as observed at one major traffic crossing in New Delhi, is given in Table 1. After taking a look at Table 1, one will realise that the present-day traffic control is not so simple. The other part of the traffic control, which many readers may not be aware of, is also equally important for the smooth flow of the traffic on major roads, where one finds a road crossing after every hundred metres or so. This is called

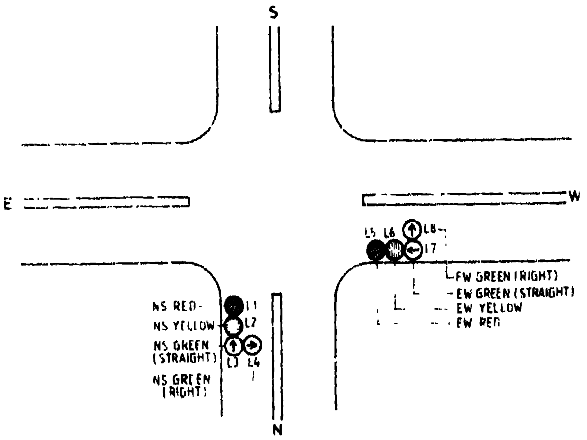

Fig. 1: Typical traffic light system on the road crossing.

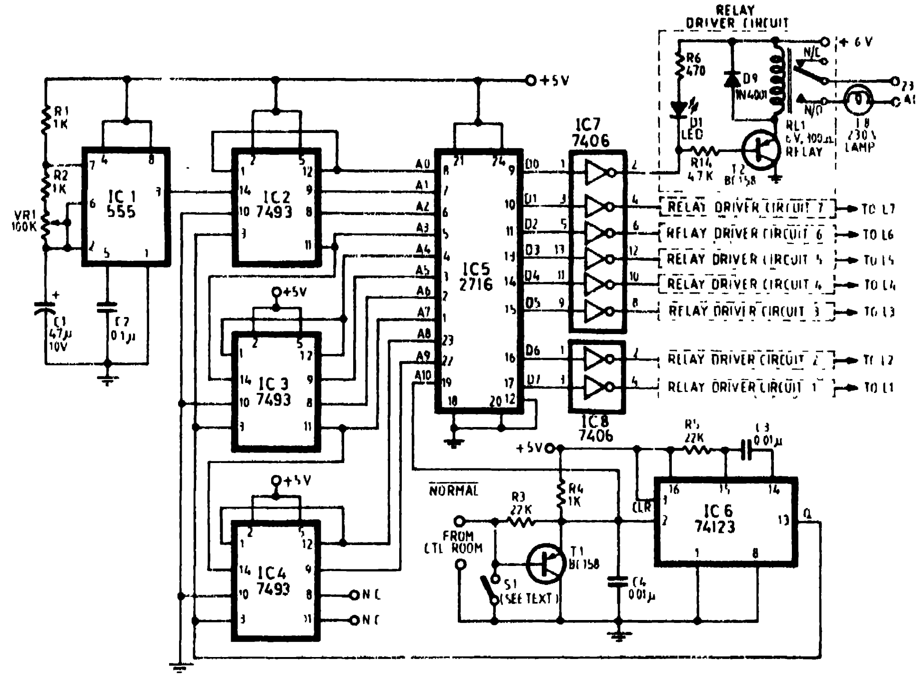

Fig. 2: Circuit diagram for traffic light control system.

PARTS LIST

Semiconductors:	
IC1	— NE555 timer
IC2-IC4	— 7493/74LS93 divide-by-sixteen counter
IC5	— TMS2516/2716 EPROM
IC6	— 74123/74LS123 dual multivibrator
IC7, IC8	— 7406 hex inverter
T1—T9	— BC158 pnp transistor
D1—D8	— 5mm red LED
D9—D20	— 1N4001, 1 amp rectifier diode
***Resistors** [all 1/4 watt, ±5% carbon]:*	
R1, R2, R4	— 1-kilohm
R3, R5	— 22-kilohm
R6—R13	— 470-ohm
R14—R21	— 4.7-kilohm
VR1	— 100k linear potentiometer
Capacitors:	
C1	— 4.7µF, 16V electrolytic
C2, C6—C9	— 0.1µF, 12V ceramic
C3, C4	— 0.01µF, 12V ceramic
C5	— 4700µF, 25V electrolytic
Miscellaneous:	
S1	— SPDT switch
RL1—RL8	— 6-volt, 300-ohm relay
L1—L8	— 230V, 100-watt lamp
	— PCB, IC sockets, LED holder, Lamp reflecter, cables, enclosure, hardware etc.

'synchronisation' of various traffic lights through remote control. Here, the timings of various traffic lights at different crossings on one major road are adjusted in such a way that once the traffic finds 'green' light on the major (main) road, it should find green light at the next crossing too, if the traffic is moving at the recommended speed. The traffic control for the outer circle of Connaught Place of New Delhi is one such example.

The traffic light control system should also have the facility to operate in the so-called 'Hold Mode'. In this mode, the normal sequence of lights is discontinued and only yellow (or red) lights keep blinking to caution the traffic. The hold mode is normally used during late night hours or early morning hours, or when the traffic is to be controlled manually.

Now let us study a simple traffic light control circuit which uses a minimum of components. The circuit will be able to perform all the above-mentioned operations.

The circuit

The circuit for the traffic light control is given in Fig. 2. The suitable power supply for the system is given in Fig. 3.

The most familiar clock generator IC 555 is used in astable mode to generate the basic clock. The clock frequency can be adjusted by varying potentiometer VR1.

The circuit uses three 4-bit binary counter ICs, 7493 (74LS93) which are connected in cascade mode to generate the 'address' for the 2716 EPROM. The four outputs (O/Ps) of the first two counters (IC2 and IC3) and two O/Ps of the third counter (IC4) are used. This makes 10 address lines, which gives two, i.e. 1024 addresses (locations/combinations). So, if we want the traffic light cycle (step 1 through step 10) to take 128 seconds, the clock should be adjusted to 1024/128, i.e. 8 Hz or 0.125 seconds. Thus, we can control the traffic light with a resolution of 0.125 seconds.

Pin numbers 18 (chip select) and 20 (output enable) of the 2716 (IC5) are grounded. So, the 2716 chip is always selected. Now, depending on the address present at the address lines (A0 to A10), the 2716 will give out the data, which is already stored (programmed) at that address.

TABLE 1

Step	Lamp 1 NS Red	Lamp 2 NS Yel	Lamp 3 NS Grn	Lamp 4 NS Grn R Turn	Lamp 5 EW Red	Lamp 6 EW Yel	Lamp 7 EW Grn	Lamp 8 EW Grn R turn	Remark	Time Secs.
1	1	0	0	0	1	0	0	0	Both Roads Red	2
2	0	0	0	1	1	0	0	0	NS Red OFF; NS Grn (R Turn) ON	22
3	0	1	0	0	1	0	0	0	NS Grn (R Turn) OFF; NS Yel ON.	2
4	0	0	1	0	1	0	0	0	NS Yel OFF; NS Grn ON.	24
5	0	1	0	0	1	0	0	0	NS Grn OFF; NS Yel ON.	2
6	1	0	0	0	1	0	0	0	Both Roads Red	2
7	1	0	0	0	0	0	0	1	EW Red OFF; EW Grn (R Turn) ON	22
8	1	0	0	0	0	1	0	0	EW Grn (R Turn) OFF; EW Yel ON	2
9	1	0	0	0	0	0	1	0	EW Yel OFF; EW Grn ON.	34
10	1	0	0	0	0	1	0	0	EW Grn OFF; EW Yel ON.	2
									Total	114

Abbreviations:

0	Lamp 'off'
1	Lamp 'on'
NS Yel	North-South Yellow
NS Grn	North-South Green (Straight)
NS Grn (R Turn)	North-South Green (Right Turn)
EW Yel	East-West Yellow
EW Grn	East-West Green (Straight)
EW Grn (R Turn)	East-West Green (Right Turn)

The O/Ps of 2716 are connected to the 7406 inverters. The 7406 is hex buffer/driver with open collector O/Ps, which can source/sink up to 30 milliamperes of current and the O/Ps can be connected to DC voltage up to 30 volts.

One light emitting diode (LED) is connected to the O/P of 7406 inverters through a current limiting resistor (R6). In our example, we have used 470-ohm resistor. In case the positive supply is not 6 volts (if some other relay with different coil voltage is used), the current limiting resistor should be modified accordingly. About 8 to 12 milliamperes of DC current is sufficient for a normal glow of the LED. So, if the positive supply voltage is 12 volts, R5 may be changed to 1k or 1[illegible]k. Similarly, for 24 volts positive supply, a 2.2k resistor may be used. The LEDs are used only for visual indication and testing of prototype, and are not required for the functioning of the circuit, and therefore may be eliminated, if so desired.

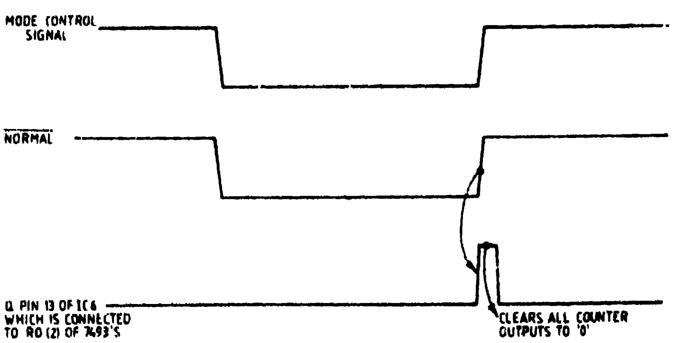

Fig. [illegible]: Suitable power supply for the circuit.

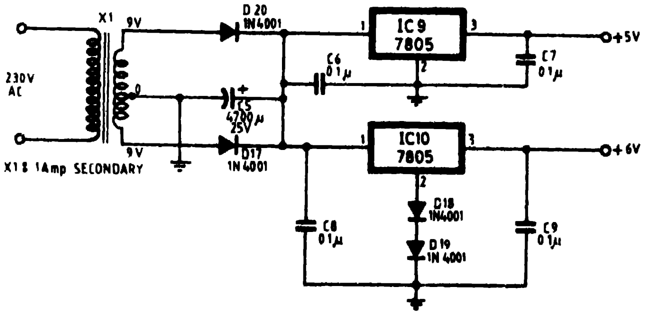

Fig. 4: Synchronisation timing waveform at various modes.

The base of a pnp transistor (T2) is connected to the O/P of 7406 inverter through a 4.7k resistor. The collector of the pnp transistor is connected to ground and a DC relay is connected through positive supply to its emitter. (In our example, we have used a 6V DC relay.)

So, when the O/P of 2716 chip is high (say, D0, i.e. pin 9 of 2716), it will be inverted and pin 2 of 7406 will become low. This will turn 'on' the LED and also transistor T2. Thus, the relay coil will be energised and lamp 8, which is connected through the relay contacts will turn 'on'. On the other hand, if the 2716 O/P is low, the 7406 inverter O/P will be high and the LED as well as the transistor (and thus the relay) will remain off. Thus, we can control all the eight lamps in any combination.

The relay driver circuit in our example uses BC158 driver transistor. It will be suitable, as long as the coil current is less than 400 mA. In case some other DC relay is used, the driver circuit may have to be modified. In case the relay coil voltage is less than 30 volts and the coil current is less than 100 mA, the same circuit may be used. However, if relay coil voltage is less than 30 volts but the coil current is more than 100 mA, some other pnp transistor with higher power rating (say, ECP055) has to used. But in case of more than 30V DC relay, the 7406 IC cannot be used and a suitable driver circuit has to be redesigned.

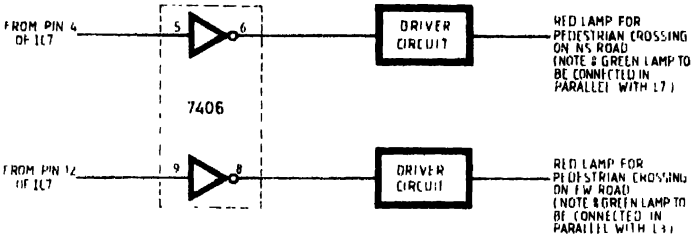
FROM PIN 4 OF IC7
5
6
7406
FROM PIN 12 OF IC7
9
8
DRIVER CIRCUIT
DRIVER CIRCUIT
RED LAMP FOR PEDESTRIAN CROSSING ON NS ROAD (NOTE 8 GREEN LAMP TO BE CONNECTED IN PARALLEL WITH L7)
RED LAMP FOR PEDESTRIAN CROSSING ON EW ROAD (NOTE 8 GREEN LAMP TO BE CONNECTED IN PARALLEL WITH L3)

Fig. 5: Addition to main circuit to implement the pedestrian lights.

Power supply

Power supply for the traffic control circuit is very simple as it requires only +5 volts. The power supply circuit uses one step-down transformer, two rectifier diodes D17 and D20), one filter capacitor (C5) and a+5-volt voltage regulator IC9 (7805 or equiv.). The voltage regulator should be mounted on a suitable heatsink.

The DC supply for the coils of the relays can be generated by using either an adjustable voltage regulator (78HG) or by simply connecting two diodes to the 'common' terminal of the 7805 voltage regulator, as shown in Fig. 3. The circuit will give around 6 volts DC supply.

The voltage regulator should be mounted on a suitable heatsink. The common terminal of the voltage regulator should be isolated from the heatsink. In case the relay coil voltage is other than 6 volts, a suitable power supply has to be designed for driving the relay coils.

Operation of the circuit

The operation of the circuit is very simple. As explained earlier, IC 555 generates the basic clock for the circuit, which is fed to a chain of three 7493s that generate 10 address lines for the 2716 chip. These lines are A0 through A9.

The 'mode control signal' which comes from the 'control room' is connected to the base of a transistor T1. If the base of T1 is open/high, the transistor will remain in cut-off state and the signal $\overline{\text{NORMAL}}$, which is connected to A10 (the most significant address line) of the 2716, remains high. And, if the mode control signal is low, or if switch S1 is closed, transistor T1 conducts and the signal $\overline{\text{NORMAL}}$ (A10) becomes low. The signal $\overline{\text{NORMAL}}$ is also connected to one monoshot IC 74123 (IC6). Its function will be explained in the latter part of this article.

As the 2716 has 11 address lines, it contains 2k, i.e. 2048 bytes of data. So, if the most significant address line (A10) is low, the lower 1024 (1k) address locations are selected (Address: 000 to 3FF hex). And, if A10 is high, the upper 1k addresses are selected (Address: 400 hex to 7FF hex). The lower 1k bytes are used to store data for hold mode and the upper 1k bytes are used for normal mode.

Now let us study the normal mode, the hold mode and synchronisation in detail.

Normal mode

As explained earlier, A10 is high during this mode and the upper 1k bytes are used to store data for this mode. The total time taken to complete one traffic cycle in our example (Table 1) is 114 seconds for all the 10 steps. This time has to be covered in 1024 clock cycles. Therefore, the clock frequency should be 1024/114, i.e. 9 Hz approximately.

The duration of step 1 is 2 seconds. So, 9×2, i.e. 18 addresses (locations) will be used to store the duration corresponding to step 1. Therefore, step 1 will start at address 400 hex and continue up to 411 hex (400 hex to 411 hex, both inclusive, is 18 locations), and since lamp 1 (bit 7) and lamp 5 (bit 3) should be 'on' (and rest all 'off'), '1000 1000', i.e. 88 hex should be stored at these address locations.

The duration of step 2 is 22 seconds, which will be covered in 22×9, i.e. 198 clock cycles. Since only lamp 4 and lamp 5 should be 'on' during step 2, the data '0001 1000' (18 hex) should be stored from 412 hex to 4D7 hex locations. Similarly, we can calculate the addresses and the data stored therein for other steps too. These values are listed in Table 2.

TABLE 2

Steps	Duration	Clock Cycles	Address (Hex)	Data (Hex)
1	2	18	400 - 411	88
2	22	198	412 - 4D7	18
3	2	18	4D8 - 4E9	48
4	24	216	4EA - 5C1	28
5	2	18	5C2 - 5D3	48
6	2	18	5D4 - 5E5	88
7	22	198	5E6 - 6AB	81
8	2	18	6AC - 6BD	84
9	34	306*	6BE - 7EE	82
10	2	18	7EF - 7FF	84

* Actually 304 address locations are used so as to make the sum of the clock cycles, for all the steps, equal to 1024. This will reduce step 9 to 34 × 304/306, i.e. 33.78 seconds.

So, if the 2716 contains data as per Table 2, and A10 is high, the 2716 will continue to give data which will control the relays, which in turn finally control the traffic lights as per our requirements. The address will start at 400 hex and will keep on getting incremented, and the 2716 will keep on selecting new steps after required number of clock cycles

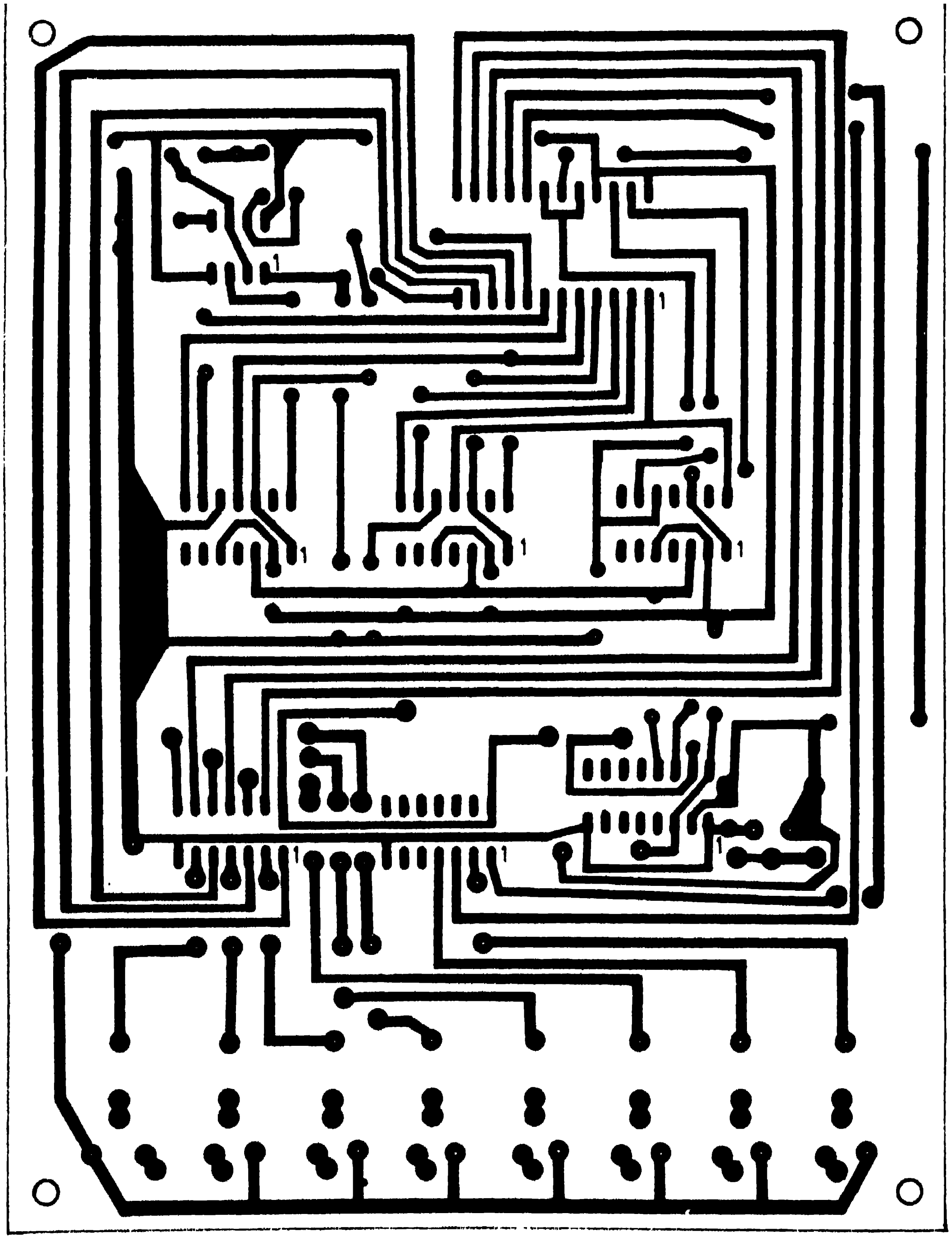

Fig. 6: Actual size PCB layout for the circuit.

when the current steps are over. When the address becomes 7FF (the last address for step 10; also last address of the 2716), it will once again become 400 hex at the next clock cycle. So, the traffic light will continue to run in normal mode.

Hold mode

The hold mode is similar to normal mode, except that the lower half of the 2716 (lower 1k bytes) is used and the A10 is low during this mode. The circuit can enter into this mode by closing switch S1 or by making 'mode control line' low through remote control.

In hold mode, the yellow lights keep on blinking. Let us fix the blinking rate to 0.5Hz, i.e. yellow lights are on for one second and off for the next one second. As per Table 1, lamp numbers 2 and 6 are used for yellow lights.

As we are using 9Hz clock, we should store '0100 0100', i.e. 44 hex data in the first 9 locations (000 to 008) and '0000 0000' should be stored in the next 9 locations, and then '44' hex in next 9 locations, and so on. This should be continued up to address 3FF hex.

Since in hold mode the A10 remains low, the address starts at '000' and is incremented up to '3FF'. Thereafter, it once again starts from '000'. So, in hold mode the yellow

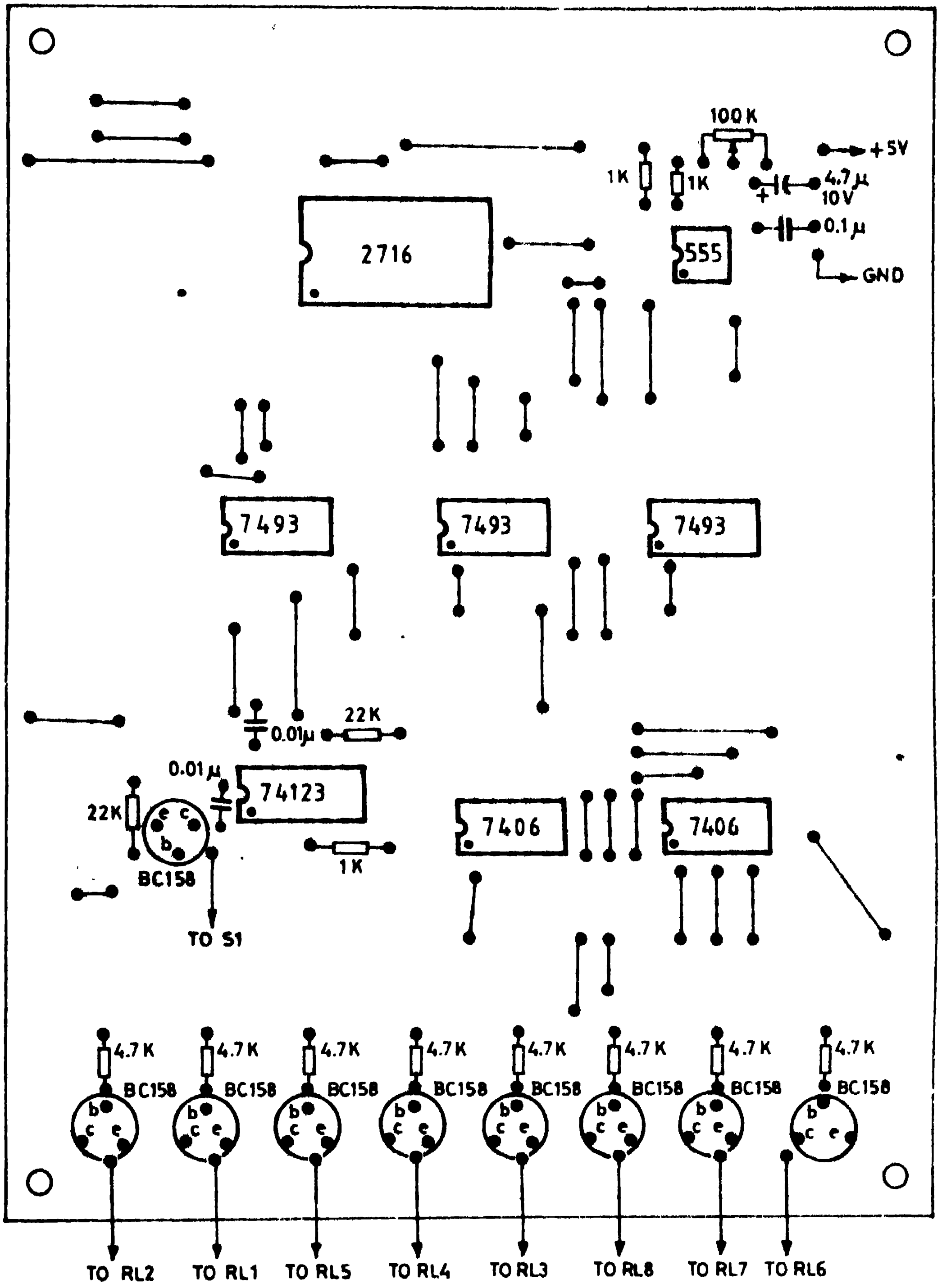

Fig. 7: Components layout for the PCB.

lights will keep blinking at 0.5Hz rate.

In case some other blinking rate is required, it can be easily achieved by varying the number of locations for lights that are on (data '44') and the lights that are off (data '00') in the 2716.

Synchronisation

Synchronisation means starting the traffic lights from step 1 at a particular moment, through remote control. As explained earlier, this helps in smooth running of traffic on busy roads.

We have not explained the function of 74123 (IC6). The IC 74123 contains dual monoshots. Only one monoshot is used in this circuit. The circuit is configured in such a way that it triggers the monoshot at the 'positive going pulse' at 'B I/P' (pin 2 of IC6).

IC6 is used here for synchronisation. For using this feature, first we have to put the control circuit in hold mode by making mode control signal 'low'. As a result, the $\overline{\text{NORMAL}}$ line becomes low. But this does not 'trigger' the monoshot of IC6, as the monoshot (IC6) is configured to trigger on high going pulse only. But when the 'low' level from the mode control line is removed, the $\overline{\text{NORMAL}}$ line goes from low to high. This triggers the monoshot and a 'high' pulse is generated at the 'Q O/P' of 74123, which is connected to the 'R0' (pin 3) of the counters. This sets the O/Ps of all the counters to zero. The timings are shown in Fig. 4. So, the effective address applied to the 2716 chip is '400 hex' ($\overline{\text{NORMAL}}$ (A10) is high) and the control sequence starts from step 1. Thus, the traffic lights can be put in synchronisation by making mode control line low and then high at the desired moment.

So, we have seen that this simple circuit has all the features of a good traffic control system. It is also possible to have two 2716 chips in the circuit so that two traffic light control sequences are stored, and any one of the two sequences may be selected with the help of a simple switch. For doing this, all the pins of both the 2716 chips, except pin 18, should be joined together. Pin 18 of the two 2716 chips should be connected through a DPDT switch in such a way that the switch makes pin 18 of the first chip low (and that of the other chip high) when in one position and vice versa. Thus, the chip with a low pin 18 will be selected and the control sequence stored therein.

In case more than 8 O/P lines are required, two 2716 chips should be used in such a way that all the I/Ps are common (i.e. A0-A10), Chip Select (18) and Output Enable (20)). Thus both the chips will be selected simultaneously and we can control up to 16 lights (8 through each 2716 chip) in any combination.

Many traffic lights give 'green/red' signal for crossing the roads to pedestrians also. This is also possible in our original circuit. (Refer to Figs 1 and 2.) The pedestrian should cross North-South road only when there is no movement of traffic on North-South road from any direction. This condition is true only when the traffic is moving in East-West (straight) direction. Or in other words, when lamp 7 is on. So, light for the pedestrian who wants to cross North-South road should be green only when lamp 7 is on, and should be red for rest of the time. Thus, the green light in this case can be connected in parallel to lamp 7 and an inverter can be connected from pin 4 of IC7 (Fig. 2) and the O/P of this inverter can drive the driver circuit for controlling red light for pedestrian crossing. A similar addition will be required for the pedestrian who wants to cross East-West road. This is shown in Fig. 5.

All the components used in this traffic control circuit are easily available in local markets. The circuit can be easily wired on a general-purpose PCB. But some readers may find it difficult to get the 2716 EPROM programmed. If they do not have access to a PROM programmer, they may contact EFY for pre-programmed EPROMs containing data as per Table 1. □

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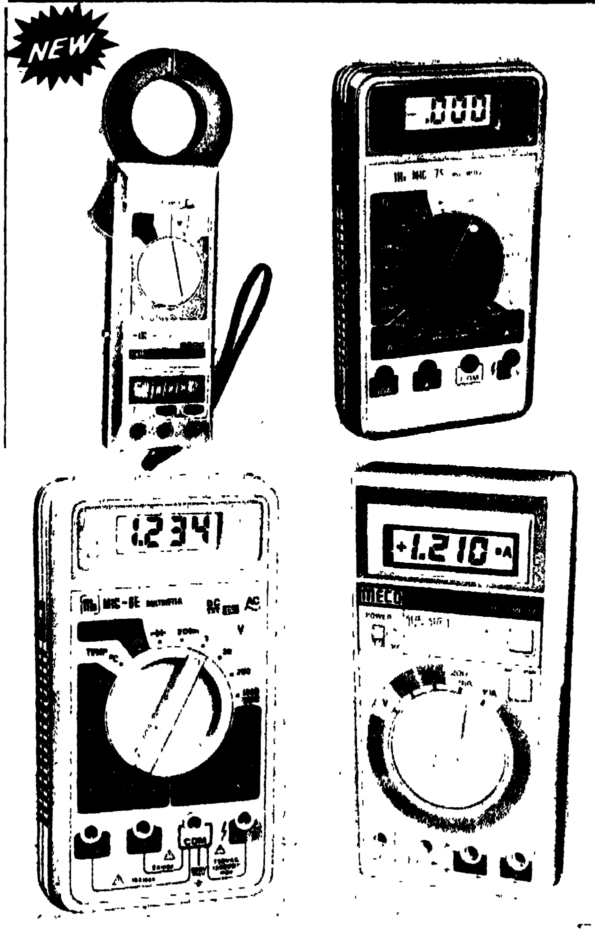

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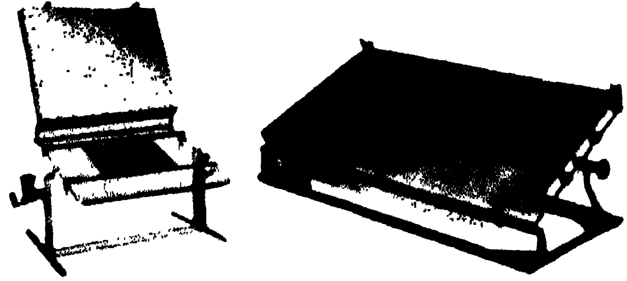

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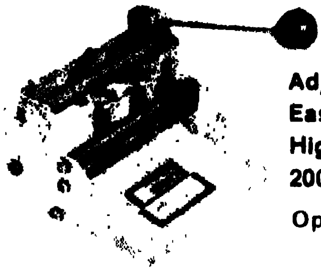

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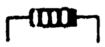
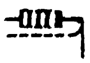
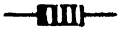
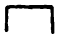
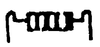
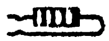
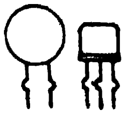
Cut and Bend	
Produce vertical mounting by bending over long leg	
cut to length	
Jumper link	
Stress relief	
Vertical Stand off	
Transistor / Capacitor Spread, Cut & form	

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GARUD

D. Gowdama Chandran

Envelope Follower For Guitars and Organs

Very little has been done in India regarding electronic musical instruments while Indian musical instruments field has been totally ignored. For amateur guitarists it is very difficult to obtain electronic gadgets since they are not made locally. Hence, an electronic musical gadget is presented here for those who are unable to buy such units because of their high cost or total non-availability.

This unit produces a similar effect as a 'Wah-Wah' which is familiar to most music enthusiasts, but it is automated. It is actually designed for electric guitars though it is equally adaptable for electronic organs. It is connected between the guitar and power amplifier and gives the 'Wah' effect automatically whenever you play the guitar. Professional grade quality can be obtained from this unit.

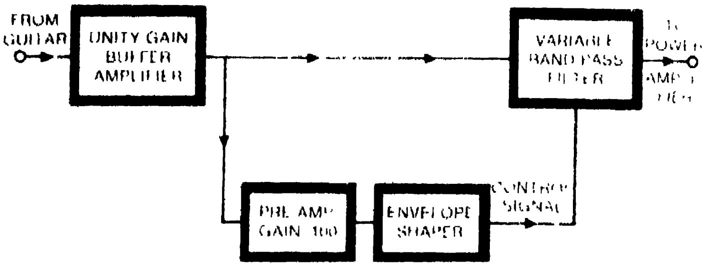
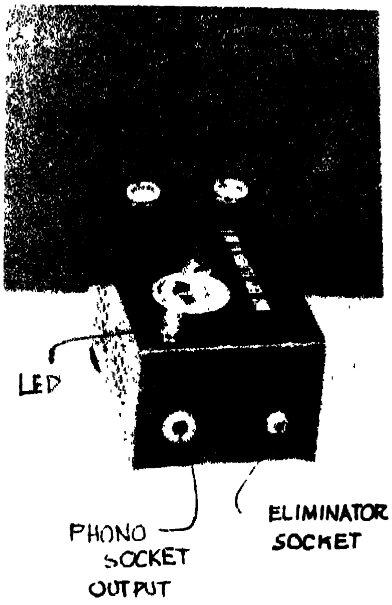


Fig. 1: Block diagram for an envelope follower.

The circuit

It is clear from the block diagram in Fig. 1 that it is a variable band-pass filter whose passband is controlled by the envelope of the input audio signal itself. The complete circuit diagram is shown in Fig. 2.

Op-amp A1 is connected as a unity gain buffer amplifier. R1, R2 and C1 are chosen to give the circuit a moderate input impedance. The inverted audio signals obtained from A1 are made to pass through a passive high-pass filter formed by C3 and R3.



The author's prototype of the envelope follower.

Op-amp A2 is connected as a preamplifier with a gain of

Mr Gowdama Chandran is an experienced guitarist as well as an electronics hobbyist, though he's a civil engineering draughtsman by profession

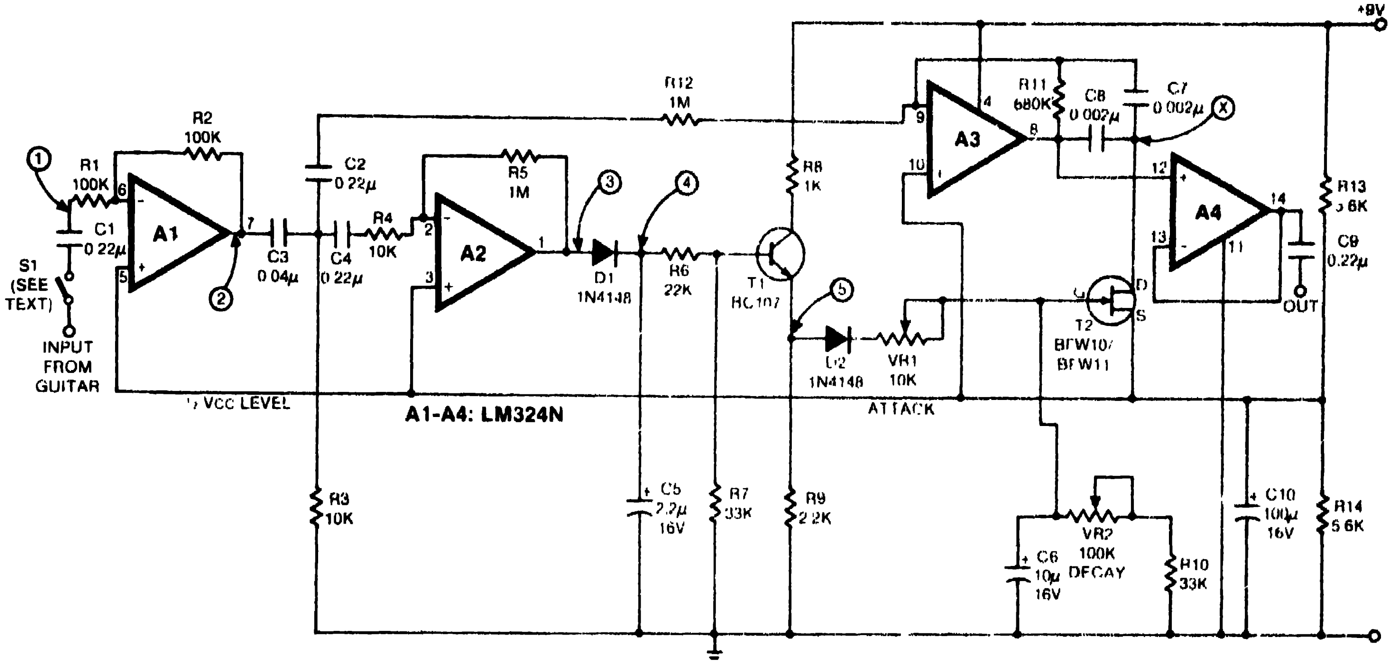


Fig. 2: Circuit diagram for the envelope follower.

PARTS LIST

Semiconductors:	
IC1	— LM324 quad op-amp
T1	— BC107 npn transistor
T2	— BFW10/BFW11 field effect transistor
D1, D2	— 1N4148 silicon switching diode
D3	— 5mm LED
Resistors [all ¼ watt, ±5% carbon]:	
R1, R2	— 100-kilohm
R3, R4	— 10-kilohm
R5, R12	— 1-megohm
R6	— 22-kilohm
R7, R10	— 33-kilohm
R8	— 1-kilohm
R9	— 2.2-kilohm
R11	— 680-kilohm
R13, R14	— 5.6-kilohm
R15	— 680-ohm
VR1	— 10-kilohm, linear potentiometer
VR2	— 100-kilohm, linear potentiometer
Capacitors:	
C1, C2, C4, C9	— 0.22µF ceramic disc
C3	— 0.04µF ceramic disc
C5	— 2.2µF, 16V electrolytic
C6	— 10µF, 16V electrolytic
C7, C8	— 0.002µF ceramic disc
C10	— 100µF, 16V electrolytic
Miscellaneous:	
S1	— Push-to-on DPDT switch
	— PCB, battery holder, phono sockets, enclosure, screws, nuts, other hardware etc.

100. The amplification is decided by resistors R5 and R4. Capacitor C4 is included to isolate the input of the preamp from negative potential.

The amplified signal is rectified by diode D1 while capacitor C5 eliminates the AC components. This DC voltage obtained is known as the envelope of the input signal.

Since the output of op-amp A2 will be at ½ Vcc at rest, the envelope signal will be swinging above this level only, which is undesirable. Hence transistor T1 is employed to lower this base level. Resistors R6 and R7 give bias for the base of T1 while R8 is used as collector load resistor. Resistor R9 has been chosen to develop the required DC level at emitter of T1.

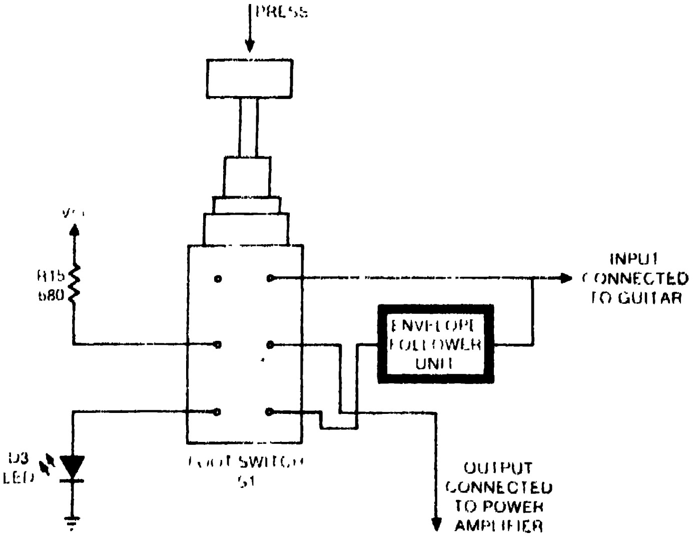
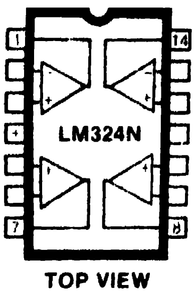


Fig. 3: Wiring diagram for foot-operated DPDT switch.

Filter

Op-amp A3 forms the band-pass fiter. R11 is the feedback resistor while C7 and C8 are the components that decide the 'Q' factor of the filter.



ig. 4: Pin configuration of IC LM324

Note that the input resistor R12 is greater in value than the feedback resistor R11 and is not connected to point 'X' in the circuit. On the contrary, it has been connected to the inverting input of A3 and gives a brilliant tone 'colour'.

C2 is the DC blocking capacitor. Resistance offered between points 'X' and ½ Vcc decides the passband of the filter. Here field-effect transistor T2 is utilised as a variable resistor connected between these two points.

Although the FET's drain and source terminals are interchangeable, they are connected to higher and lower impedance points respectively. The gate terminal is negatively biased through R10 and VR2.

The envelope voltage from T1's emitter is applied through D2 and VR1 to the gate of the FET. This voltage charges C6 which shapes the envelope. D2 prevents C6 from discharging through R9 and hence the discharge is possible through VR2 and R10 only. The 'attack' and 'decay' of the envelope is adjustable by VR1 and VR2 respectively.

At rest, the gate of T2 is negatively biased and hence a very high resistance is offered between the drain and source terminals of the FET. When the envelope is present the resistance varies accordingly. It follows that the passband of the filter is made to sweep across the audio spectrum which gives a 'Wah' effect.

The output of A3 is buffered by the voltage follower built around A4 and DC blocking capacitor C9. Finally, ½ Vcc is developed by the potential divider comprising R13 and R14, and is smoothed by C10.

The circuit is powered by a 9V, PP3 battery. It may be powered by a battery eliminator, but a regulated power supply is preferable.

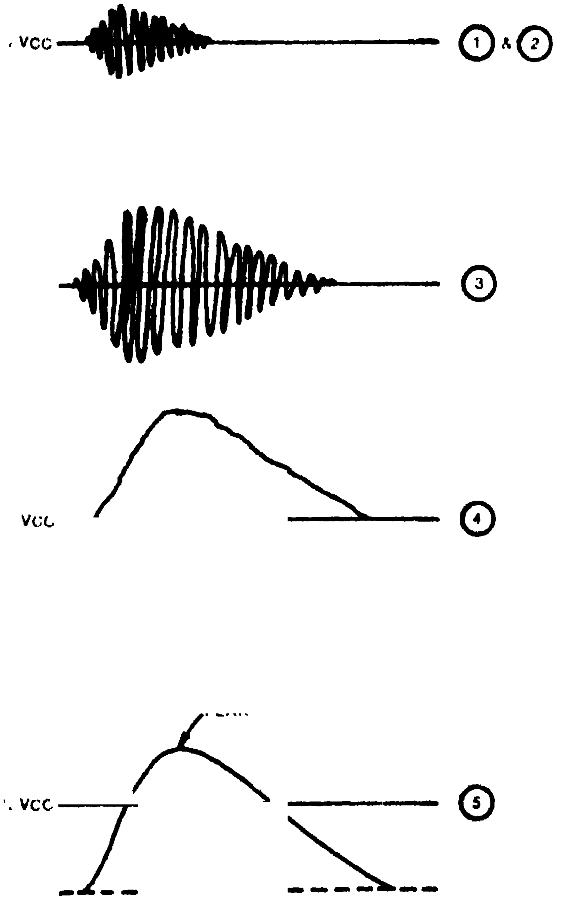


Fig. 5: Typical waveforms observed on a scope at various points in the circuit.

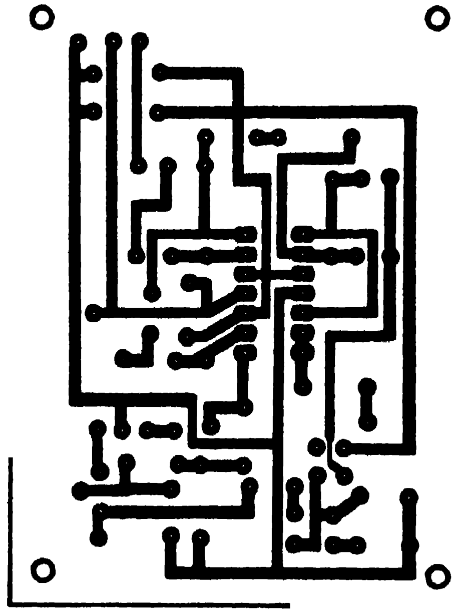
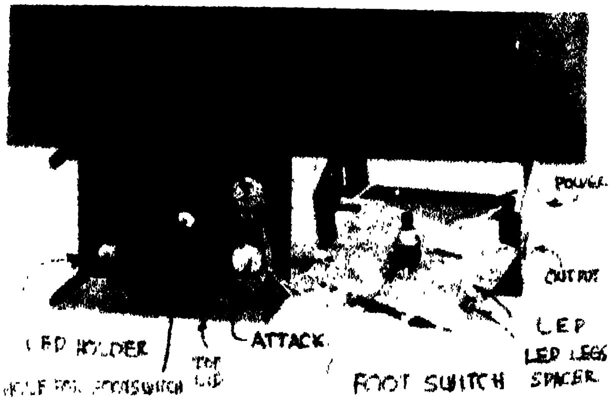


Fig. 6: Actual-size PCB pattern for the circuit.



Inside view of the author's prototype.

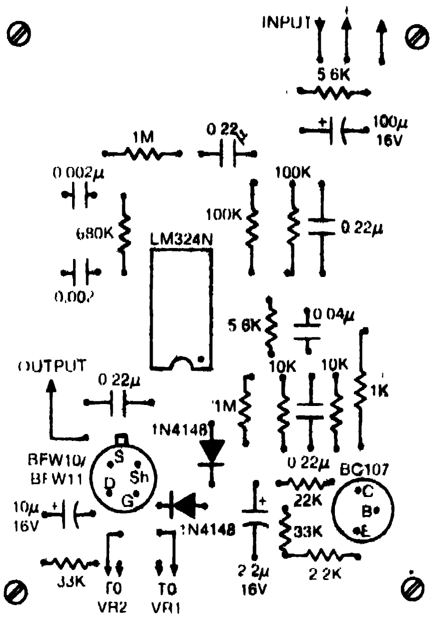


Fig. 7: Components layout for the PCB.

Construction

Any op-amp may be used for A1 to A4. However, quad op-amp LM324N is recommended for its low cost and simplicity of the layout. The pin configuration of this IC is given in Fig. 4.

The printed circuit board shown in Fig. 6 makes the construction simple and easy. The assembled board may be housed in an eliminator box to save the labour for cutting and bending sheet metal for a special enclosure. A foot switch should be provided at the top of the box to permit easy switching 'in' and 'out' of the unit in the guitar-amplifier path.

An LED is provided to indicate whether the unit is switched 'in' or 'out' of the circuit. Note that the LED should be mounted on the top lid of the box. VR1 and VR2 should also be mounted on the top lid, without obstructing visibility of the LED.

Phono sockets can be used for signal 'in' and 'out' terminals. The power supply may be kept outside the box in another case of a battery eliminator.

The assembled unit should give an excellent performance with a guitar. If an organ is connected to it, the components responsible for 'attack' part of the envelope should be modified. A resistor of 10k to 47k value should be inserted between D2 and VR1, depending upon the signal level of the organ used. □

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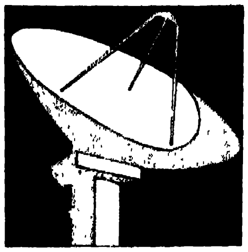

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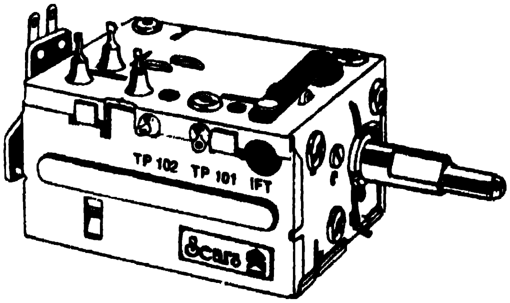

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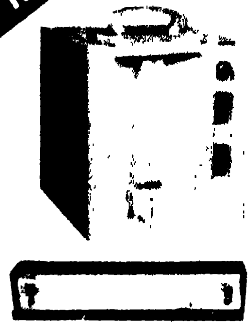

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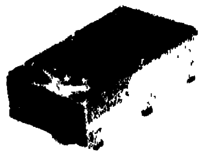

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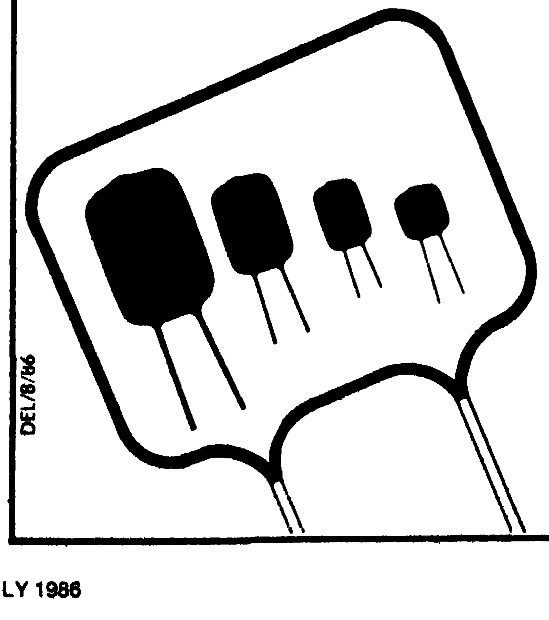

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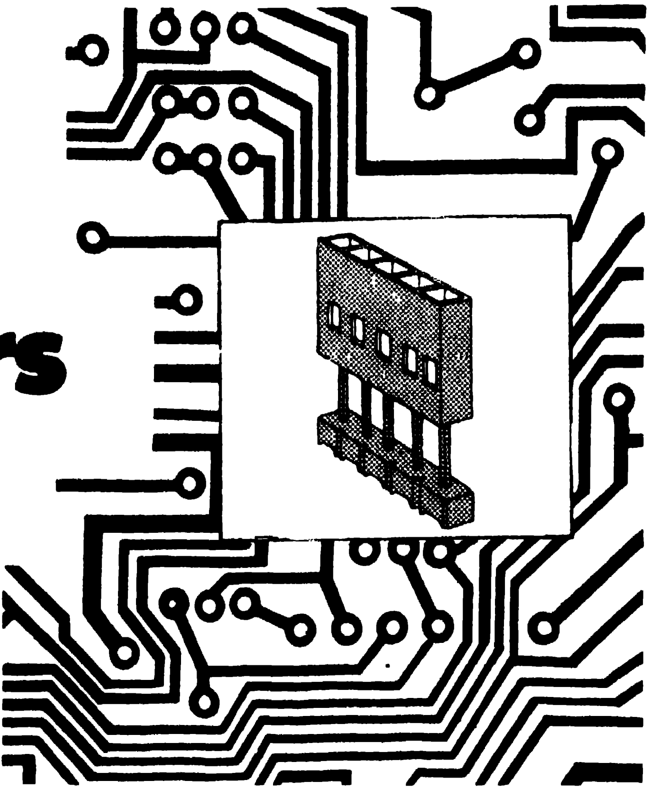

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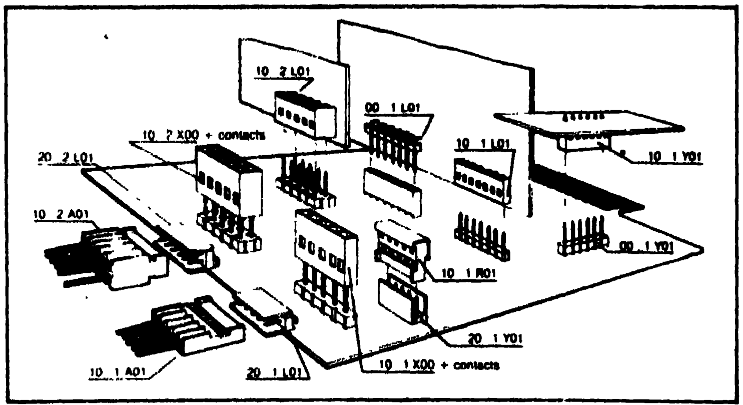

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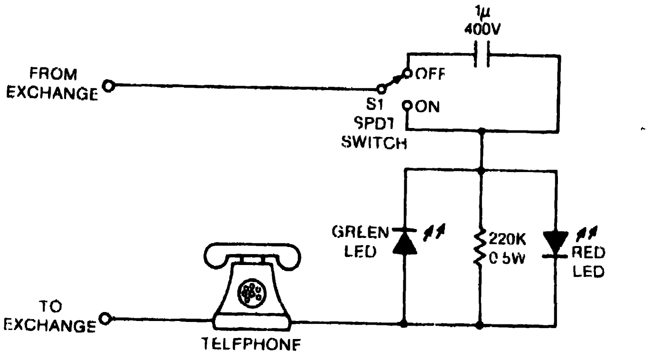
Electronic Phone Lock

This very simple to construct device can be housed in a small plastic cabinet of the size of a match box. It is to be connected in series with the phone as shown in the diagram.

When the handset is removed from cradle, one of the LEDs lights up, indicating that the phone is not dead. And on dialing the required number, the LEDs start flickering, indicating that the number is being dialled. This way one can detect whether someone is misusing the phone from the wires going outside the house.



Once the ringing tone reaches the caller and the caller lifts his own handset, the other LED lights up indicating that the call is matured. (For differentiation, two different coloured LEDs have been used.) This happens due to reversal of the polarity of voltage in the exchange wires.

When switch S1 is moved to 'off' position, the capacitor is introduced in the circuit. In this position the phone becomes 'dead' for the outgoing calls but the incoming calls regularly come through the capacitor, i.e. you can listen to the voice of the caller but they cannot listen to your voice. So, to enable the incoming calls, the switch should be moved to 'on' position and the conversation made as usual.

R.K. GUPTA

Field Failure Protection for DC Motors

The speed of a DC motor is extensively used for industrial applications where a precise speed control and a constant torque are desired. It is inversely proprotional to its field urrent. In case of field current failure, the motor speed will rise to dangerously high level. A field failure protection is herefore necessary to cut off the armature supply in case of field current failure.

The basic circuit of the field failure protection uses an ordinary 6V electromagnetic relay of the open type with 10 amps rated sturdy contacts. This relay can be used on a manual autotransformer-controlled DC drive. This motor has a shunt field current of 1.13 amps at 220V DC. A 5-ohm (25-watt) wirewound resistor (R1) connected in series with the motor field produces a 5.6-volt drop across resistor (R1) as long as the field current exists, thus energising the 6V DC relay connected across the resistor as shown in Fig. 1.

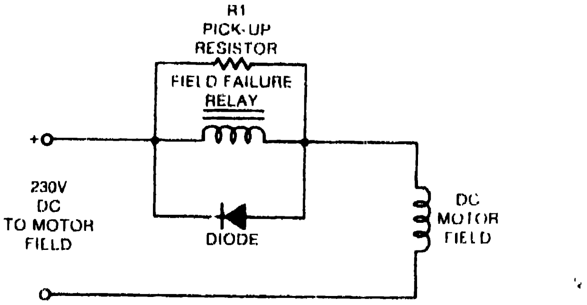


Fig. 1

In case the motor field current fails due to any fault, the voltage drop across resistor (R1) will be zero which de-energises the relay (FFR) and cuts off the armature supply.

The circuit diagram of a manual autotransformer-controlled DC drive of a 230V, 5HP DC motor with a separately excited shunt field of 230 volts (1.13 amps) and the FFR (field failure relay) circuit are shown in Figs 2 and 3 respectively. When the start pushbutton S2 is pressed, the contactor C is energised through S2 (N/O contact), limit switch S3 and stop pushbutton S1 (N/C contact).

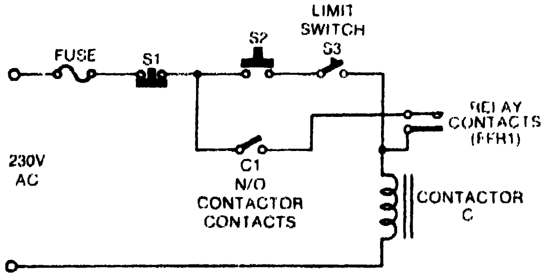


Fig. 2

The limit switch S3 is actually a part of the autotransformer, and it is so mounted that its contacts remain closed only when the autotransformer setting is at zero position. At all other settings of the autotransformer, the limit switch contacts remain open. This is a safety device introduced, so that the motor can be started only from the minimum position of the autotransformer setting, thereby starting at reduced voltage and current. If the motor is started on a high armature voltage, the starting current will be very high, especially if started on load, as is usually the case.

As soon as the contactor C is energised, its contacts C1-C3

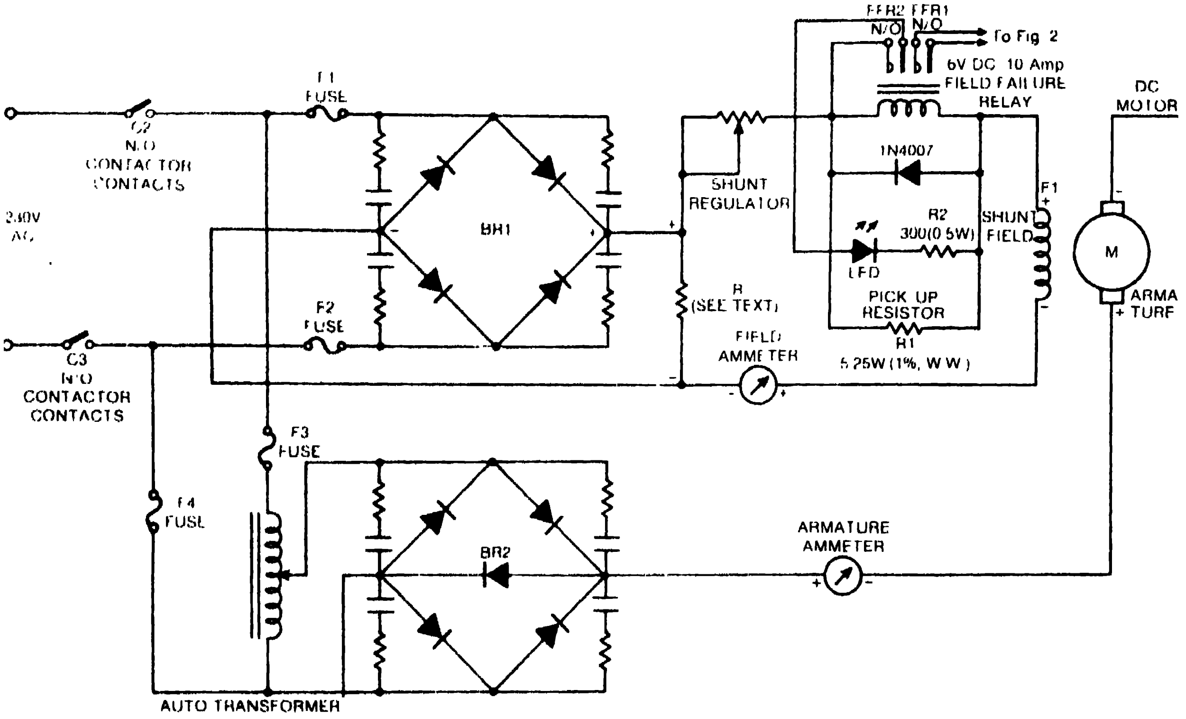


Fig. 3

are closed. A 230V AC is now available at the autotransformer input terminals, and a 230V DC via full-wave bridge rectifier BR1 and series resistor R1 to the motor field winding.

As soon as field current flows, the drop across R1 energises the FFR. FFR has got two pairs of N/O contacts, FFR1 and FFR2, which now close. FFR1 when closed provides a retaining supply to contactor C through its own contact C1, and becomes independent of S2 (which can now be released) and S3.

The motor can now be started by increasing the autotransformer setting whereby the output through the bridge rectifier BR2 applies a DC voltage to the motor armature to smoothly start the motor at a speed depending upon the setting of the autotransformer. In case of field current failure, FFR drops and contactor C opens to disconnect armature supply.

The FFR2 contacts (which are optional, but are useful as shown here) provide an LED indication that the FFR is operating. Alternatively, an ammeter can be used in the field circuit to show that the field current is flowing.

The RC network across the diodes is for surge protection of the diodes only. Usually a wirewound resistor (20k, 25W if the field excitation voltage is 230V DC) is connected across the rectifier output to the highly inductive field winding, whereas a fifth diode is connected with reverse polarity across the bridge rectifier (BR2) output to the armature.

Note that R1 (5-ohm), connected in series with the field winding will have negligible effect in the field current (field resistance being above 200 ohms). However, if one wishes to reduce the voltage drop across R1, two 5-ohm, 15W resistors may be used in parallel, and the FFR replaced by a 3V DC-operated relay which is available with some manufacturers.

Note: EFY is not responsible for any malfunctioning in the circuit as the same has not been tested in our lab.

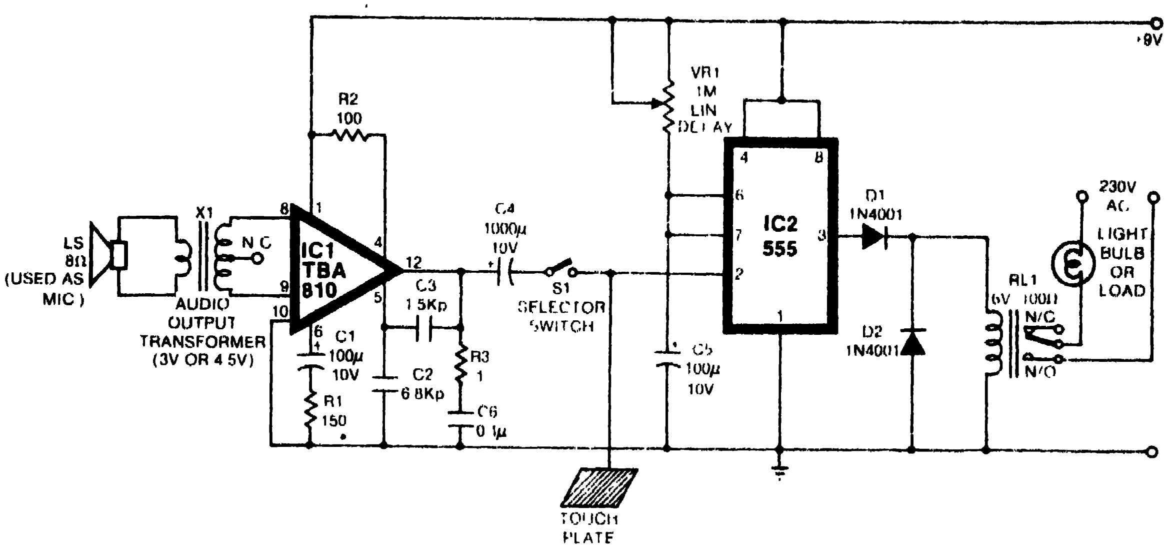
E. AUGUSTINE

Clap Switch-Cum-Touch Switch With Timer

The two-in-one circuit described here is very simple. It can be used as a sound or clap switch with timer, and also as a touch switch with timer. It will cost around Rs 80 only. Power consumption for this circuit is 20 mA at 9 volts when relay is in 'off' state and 100 mA at 9 volts when relay is in 'on' state.

This circuit uses TBA810, a 7-watt audio amplifier, along with IC 555 timer circuit. Output of the amplifier is given to pin 2 of IC 555 through switch S1. Output transformer of 3 volts is connected at the input of audio amplifier with its 8-ohm side towards the speaker. The centre terminal of this transformer is kept open.

When a 9-volt supply is applied to the circuit with closing switch S1, the relay operates. It remains in this 'on' state for certain interval of time due to the timer circuit. This interval of time can be changed by potentiometer VR1. When relay switches to 'off' state after some time, a clap sound made in front of speaker actuates the relay for certain interval of time



again. This process can be repeated. The range for this clap switch is about three metres if a good speaker with light cone is used.

If switch S1 is open and the metallic plate is touched with a finger, the relay operates for some time and then switches to 'off' state. So this circuit can be used as touch switch with timer.

The sound switch can be used as a doorlight. In the dark, a clap can switch on a light bulb connected in relay circuit for certain interval of time. The circuit can also be used in toy motors so that a clap makes the toy motor start rotating and stop after some time.

Similarly, touch switch can also be used for doorlight or with a toy motor as mentioned above.

To save your cash box from being stolen, you can connect a wire from touch switch to the cash box. When someone touches your cash box, an electric bell connected in the relay circuit can be sounded.

Lab Note. Sensitivity of the circuit can be increased by replacing the audio output transformer connected between IC1 and speaker with a 0-18V (500 mA) step-down transformer by connecting its primary windings to IC1 and secondary to the speaker acting as a microphone

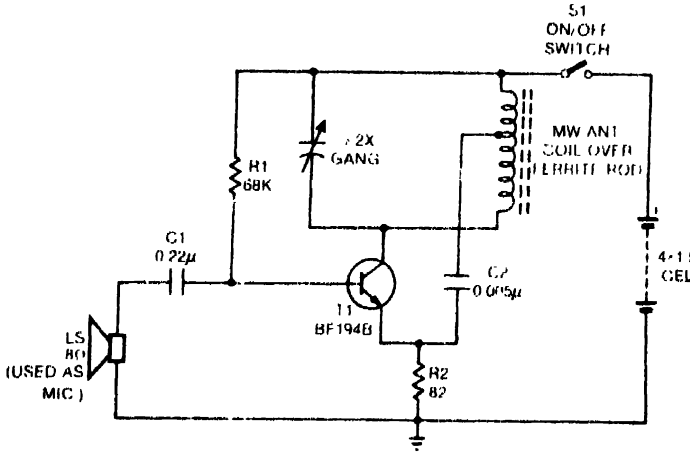
R.V. DHEKALE

Simple AM Radio Transmitter

This very simple radio transmitter uses one transistor only. Its other features are: (a) very low current drain (about 1.5 mA); (b) it works well even without any aerial (this doesn't mean that its performance with an aerial would not be better); and (c) all the components, except the loudspeaker (used as microphone), can be housed in a match box size enclosure.

The heart of the transistor is the only transistor (BF194B) which serves as many as three purposes, viz, (a) generation of RF carrier wave as an RF oscillator; (b) amplification of the audio signal coming from loudspeaker (LS) (here used as moving coil microphone) like an audio frequency amplifier; and (c) amplitude modulation of the RF carrier wave with the incoming audio signal as a modulator.

The audio signal from the microphone (LS) is fed to the base of the transistor for amplification. The collector of the transistor is connected to the resonant circuit. To continue the oscillation, a positive feedback is provided in a way similar to that of the local oscillator of superheterodyne radio receiver. The RF wave generated in this way is modulated in amplitude by the amplified audio signal. This amplitude modulated RF wave can be received by a nearby AM radio receiver tuned to the frequency of the emitted RF wave. The frequency of the emitted RF wave can be changed by varying the capacitance of VC1 (one section of a 2X gang).



Don't forget to insert a ferrite rod inside the antenna coil. Place the receiver about a metre or two from the transmitter and tune the receiver near the high frequency end of the MW band where no station is being heard. Now rotate the gang of the transmitter until you hear a hissing sound in the receiver.

The radio receiver should not be kept so close to the transmitter that it can cause unwanted feedback from the loudspeaker of the receiver to the microphone of the transmitter and break into spurious oscillation thereby producing a shrill noise. If a shrill noise is heard, increase the distance between the receiver and the transmitter until the noise subsides.

Now speak over the microphone (loudspeaker) of the transmitter and feel the thrill of hearing your own voice in the radio receiver!

This transmitter can be used for very short distance communication, say from one room to another, as an intercom. The range of this transmitter may be increased to some extent by connecting an aerial to the collector of the transistor through a capacitor of the order of 100 pF.

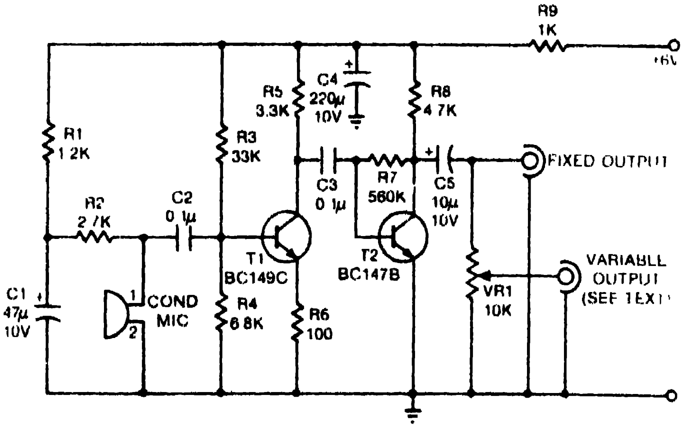
A small 6cm dia., 8-ohm permanent magnet loudspeaker fitted in a wooden cabinet is recommended for use as the microphone.

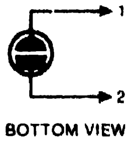
ANINDYA SUNDAR DHAR

Condenser Mike Amplifier

Need often arises for a sensitive sound pick-up device, whether it is to be used as a simple microphone or a more exotic device as a sound operated alarm, a bugging device or a sound operated flash (for stop action photography) the list is quite unending.

The circuit given employs a condenser microphone as the transducer. Since output of the condenser microphone is quite low, it usually has an FET amplifier built into the case.





BOTTOM VIEW OF COND MIC

This amp is powered by the R1, R2 resistor network.

The output of condenser microphone is fed to a two-stage amplifier. Transistor T1 (BC149C) utilising current series feedback forms the first stage. The second stage comprising transistor T2 (BC147B) is connected in the voltage shunt feedback configuration. These two stages provide sufficient gain to pick up even the slightest whisper.

This circuit requires a 4.2-volt supply. This may be obtained, as in the prototype, with a 1k (R9) resistor as shown in the diagram. The value of this resistor may be altered to suit a supply voltage other than 6 volts.

Output of the microphone amplifier can be made variable by connecting a 10k potentiometer/preset as shown.

Lab Note. Circuit's gain can be increased by reducing the value of R6 to 47 ohms or 22 ohms, depending on the input sensitivity of the main amplifier system. Increase in gain was also observed by using 3V supply and eliminating R9 altogether. The microphone should be housed in a small round enclosure.

VIVEK MEHRA

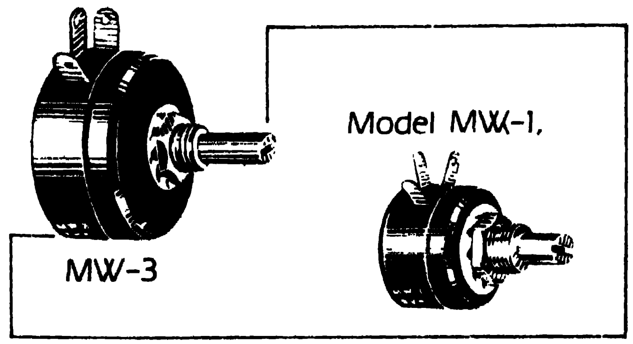
Have You Any Idea?

Do you have any circuit idea which you feel is worth sharing with the other EFY readers? If so, please do put it down neatly on a piece of paper and mail it to:

The Editor,
Circuit Ideas, Electronics For You,
605 'Siddhartha', 96 Nehru Place, New Delhi 110019.

A token honorarium (minimum Rs 50) will be paid for the ideas found acceptable for publication. But please see that your contribution fulfils the following two conditions:

1. *It has not been copied from some published material.*
2. *The circuit has been tried by you and was found to work satisfactorily.*



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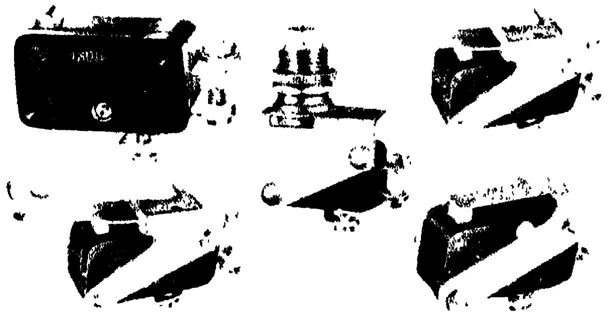

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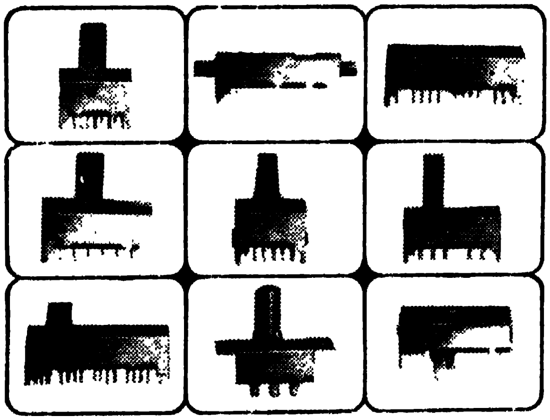

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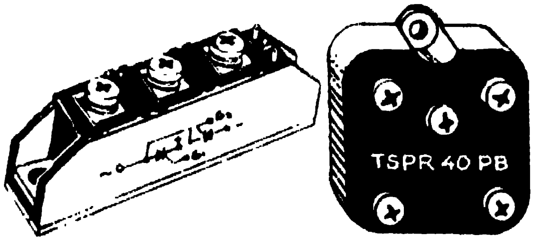

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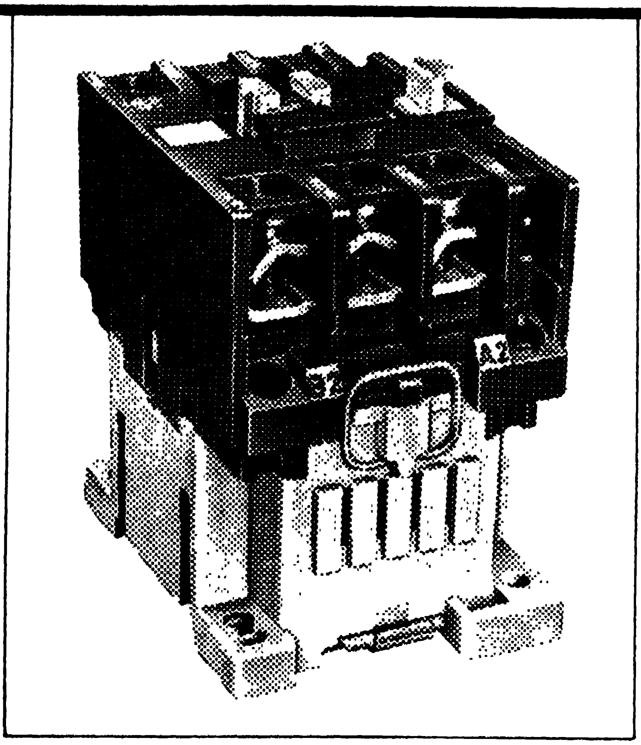

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Product Profiles

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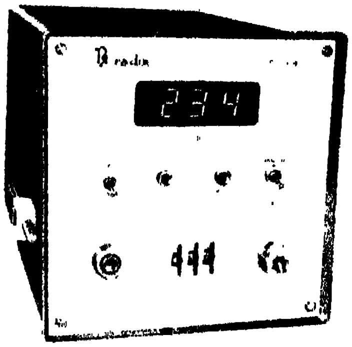
AUGER COUNTER

These are available for automatic operation with a user variable timer. For manual operation, 'remote start' inputs are provided on the back panel A front panel toggle switch allows selection of auto/manual operation. It is housed in a DIN standard 144(H) × 144(W) × 260(D) mm panel mounting box with a panel cutout of 138 × 138 mm.

Contact: Radix Electrosystems, A/22 Bonanza Industrial Estate, Kandivli (E), Bombay 400101.

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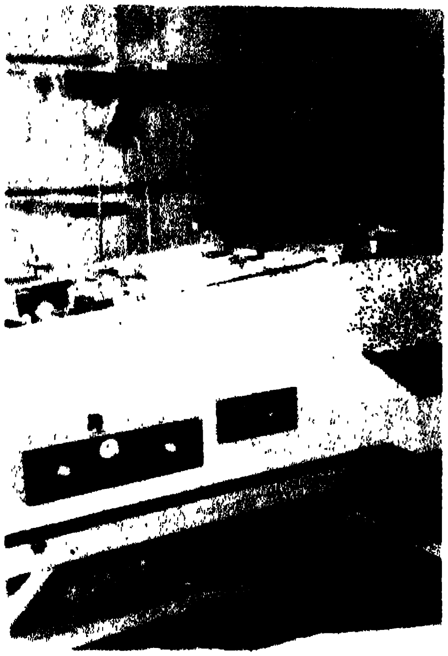
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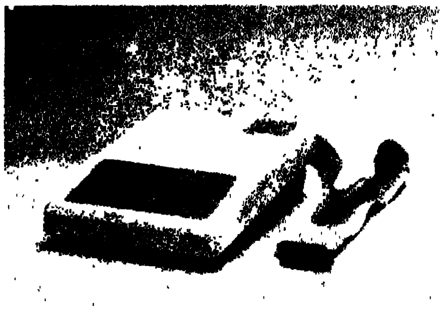
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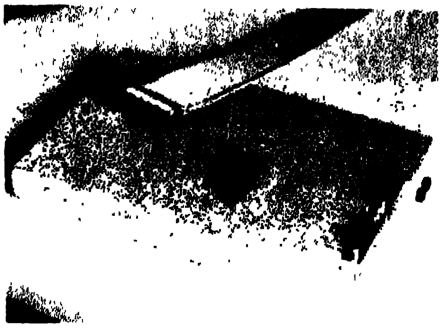
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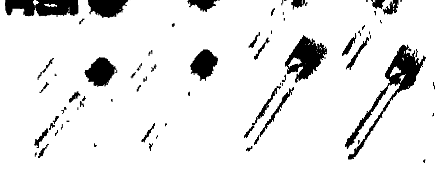

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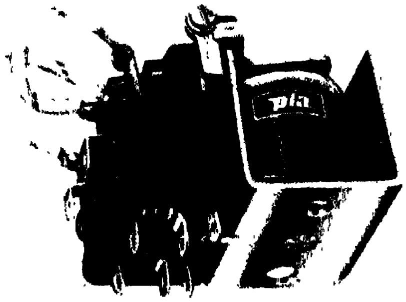

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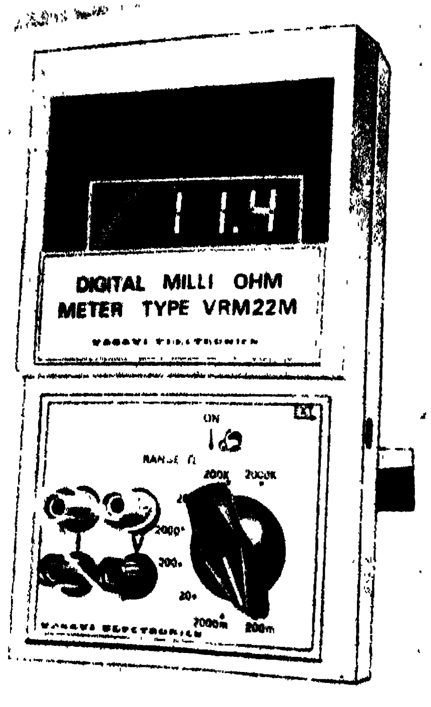

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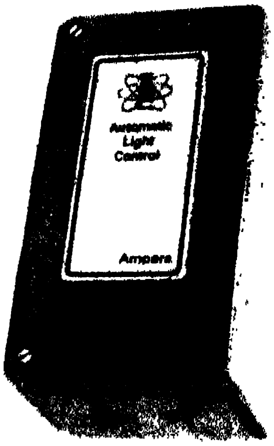

LIGHT CONTROL UNIT

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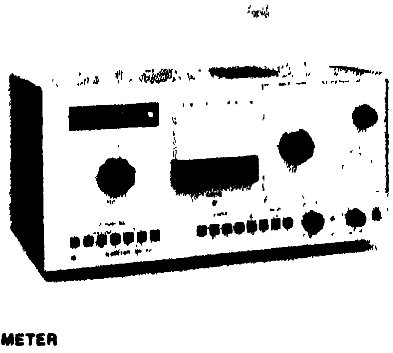

Q-METER

six-digit counter display.

Some of its salient features include: residual inductance less than 10nH, an advantage in high Q measurements and for higher accuracy; highly stable Q voltmeter circuit used for accurate measurements of low Q values; pushbuttons used for frequency and Q ranging; delta Q function provided for measuring small changes in Q, and convenient Q limit setting with lamp indication for quick sampling, checking and inspection.

Contact. Khatau Engineering Services Pvt Ltd, Post Box No. 2910, 43 Krishnanagar Industrial Layout, Dharmaram College Post, Hosur Road, Bangalore 560029

DIGITAL FUNCTIONAL IC TESTER

Microtek International Inc., Taiwan introduces Digital Functional IC Tester MATE TC 2000 which is programmed to test 1600 devices 54/74 TTL and high speed CMOS, 4000, 1800 CMOS, 55/75 TTL with maximum 20 pins. The tester incorporates key features like loop test for detecting intermittent or temperature related failures and autosearch to identify unknown ICs. Multiple self-diagnostics and built-in overload protection ensure proper functioning of the tester with accurate results.

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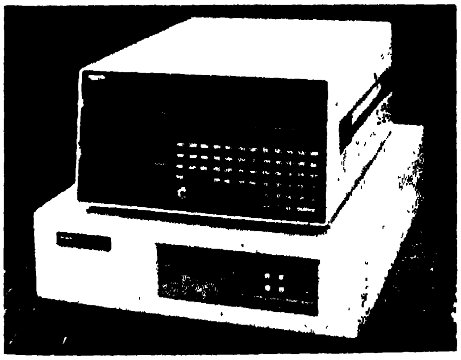

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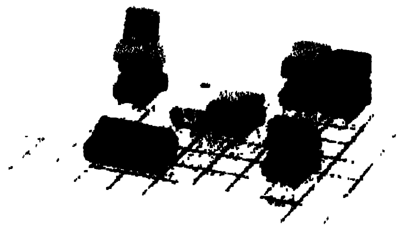

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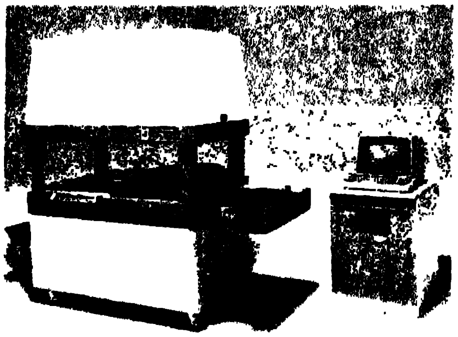

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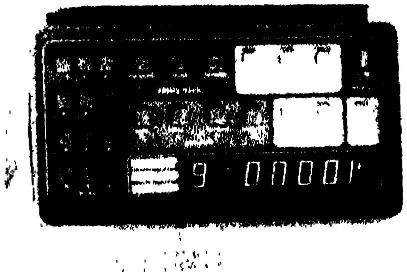

PROGRAMMABLE CURRENT SOURCE

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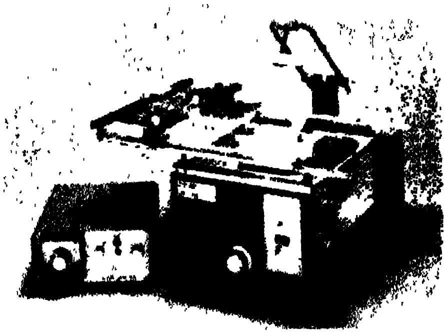
DESOLDERING TOOLS

Zevac's Desoldering Tools model PCBRM 10 Air Vac provide a strong and constant suction flow resulting in quick desoldering of multi lead components like ICs, relays, connectors etc and avoids clogging of the tools Different types of desoldering systems are available for various applications.



DESOLDERING TOOLS

Contact. Arun Electronics Pvt Ltd, Mistry Mansion, 107 M.G. Road, Bombay 400023

IMAGE PROCESSING MODULES

Imaging Technology Inc , USA, has introduced single board real time Image Processing Modules, plug compatible with VME bus, multibus, Q-Bus and IBM personal computers It contains 512 × 512 × 12 bit frame memory to store digitised images, and capable of processing the digital images in real time, and displaying the stored image in monochrome or pseudo colour It also has advanced memory architecture that allows users to randomly access individual pixels from the on-board frame memory at extremely fast rates Other important features are eight-bit analogue to digital converter for digitisation to 256 levels of gray, hardware zooming by factors of 2, 4 or 8, transparent look up table access 16 look-up tables per output channel

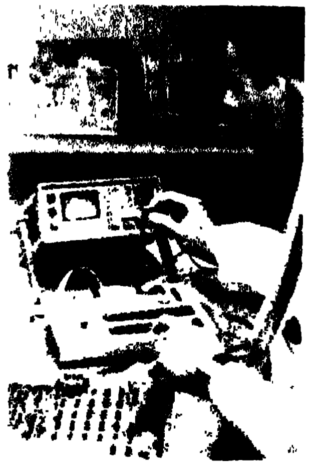
Contact Electronics Unlimited, G/65 New Cloth Market, Ahmedabad 380002

TROUBLESHOOTING TOOLS

Huntron, USA offers Portable Troubleshooting Tools—the tracker and its companion interface, the switcher These tools quickly locate digital, analogue, and hybrid circuit solidstate component failures in-circuit and power-off Trackers use a current limited sinewave voltage injected across two points of any device under test The resultant signature is displayed as a current and voltage relationship on the CRT of the tracker Straight lines and well defined junctions indicate healthy semiconductor conditions Curved lines and poorly-defined junctions indicate excessive leakage. Its power rating is 115V AC or 220/240V AC; 80 Hz

The tracker will help to provide better service for computers, peripherals, small business systems, telecommunications and industrial control equipment.

Contact: Tech Centre, 17D, Pocket IV, Mayur Vihar, Delhi 110091



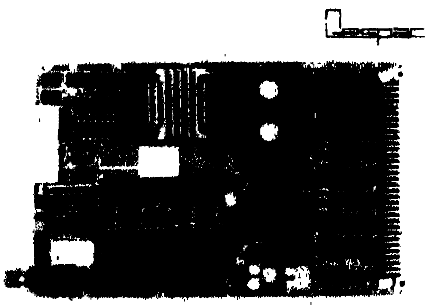
TROUBLESHOOTING TOOLS

MODULAR MICROCOMPUTERS

Gespac, Switzerland offers more than a hundred different board-level microcomputer products in their G-64 family. It offers a choice of 8, 16 and 32-bit CPUs and a family of 15 processor boards incorporating the M6802, 6809, 68000, Intel 8085, 8088, 8087, Zilog Z80, Digital J11 and National 16032 chip sets There are 11 memory boards, 21 interfaces, 21 controllers and 30 other types of function boards to choose from. Complete software support including CP/M, OS-9 operating system as well as full development microcomputer systems are also available These boards are all based on the euroboard format of single width PCBs of 10 cm × 16 cm.

The use of such standard modular building blocks or 'macro-components' greatly reduce the project completion cycle in industrial and scientific projects

Contact. Systems & Software, 910/911 Dalamal Tower, Nariman Point, Bombay 400021.



MODULAR MICROCOMPUTERS

IC SOCKETS

Aries Electronics Inc., USA offers IC Sockets in different types such as DIP type, bifurcated contact, collet contact, wire-wrap contact, round sockets (to sockets), verti sockets, elevator sockets to solder the displays, DIP headers and covers, adjustable programmers, jumpers, shorting links, jacks, zero insertion force sockets, eject sockets, single-in-line sockets, pin grid array sockets, DIP switches, connectors etc

Contact Echbee Corporation, Kamer Building, 5th Floor, 38 Cawasji Patel Street, Fort, Bombay 400001

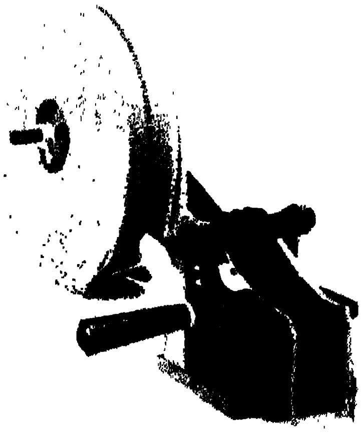
CUT-ONLY TOOLING KIT

Wybar Lead Formers introduce a new Cut-Only Tooling Kit for use on Model SF-100, hand-operated component lead cutting and forming machine

This is designed to cut axial lead components such as resistors, diodes, etc and bend the legs at 90° With this new kit, it is possible to cut the component leads to length without forming them and to cut one leg to length and the other leg to 90° to produce a vertical mounting configuration

It may be used with either taped or loose components Production rates of up to 40,000 pieces per hour are possible. It takes only a minute to install on the model SF-100 and be in production

Contact: Wybar Lead Formers, P O. Box 4961, Vincent Drive, Syracuse, New York 13221, USA.

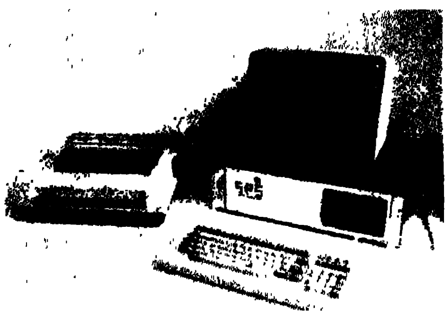


CUT-ONLY TOOLING KIT

MICROSYSTEM

SPS Microsystem from TBB Hofmann, W. Germany is a very powerful and flexible unit designed for multipurpose applications in industries, teaching and offices. Its salient features are: 6809 Motorola CPU, 64k byte on-board RAM, expandable up to 600k byte RAM, I/O ports, serial and parallel interfaces, CRT monitor with a detached keyboard, two double sided/double density 13.3cm floppy disc drives and an optional winchester disc drive

Contact: TBB Hofmann, Marienstr. 4, D-8035 Gauting/Munich, West Germany.



MICROSYSTEM

ROBOT CONTROL SYSTEM

Kombinats' Industrial Robot Control System Ursalog 5021 is ideal for spray painting and coating. When used with basic cinematic unit IFA TR10, it can control cinematic systems that have up to eight degrees of freedom (axes), potentiometric measuring systems and a hydraulic drive.

In the operational system a number of service programmes have been implemented which in case of trouble enable the operating and service personnel via alphanumeric air-conditioning indication and keyboard to rapidly detect and eliminate faults. It releases internal and external processes which are simultaneously coordinated and monitored This ensures special flexibility and thereby the re-equipment of the control system at a later date and adaptation to other basic cinematic units.

Contact: Kombinat VEB Elektro-Apparate-Werke Berlin-Treptow, "Friedrich Ebert" DDR-1193 Berlin, Hoffmannstrass 15-26.

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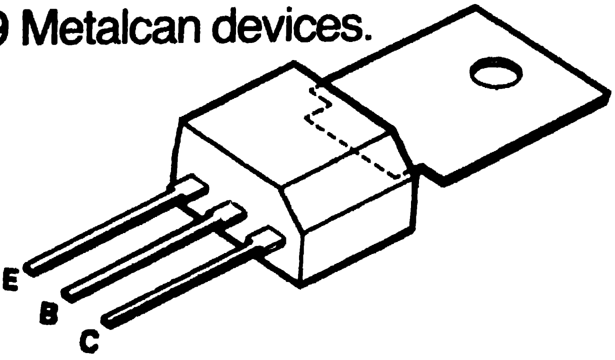

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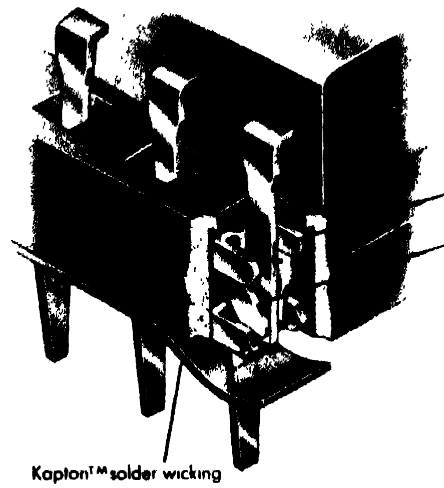

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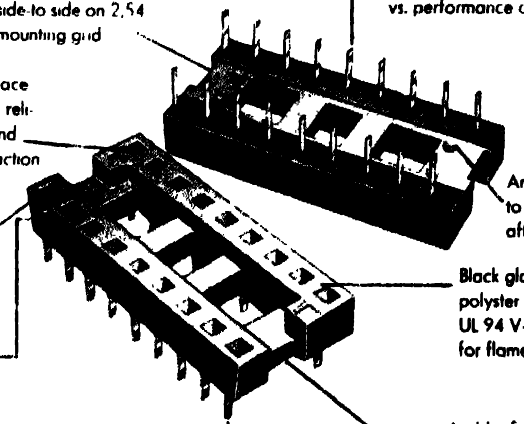

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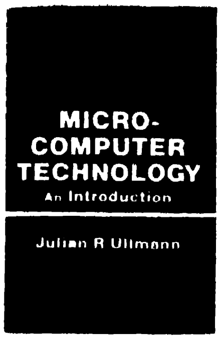
Book Reviews



Microcomputer:

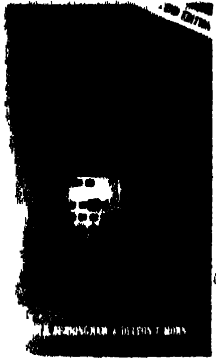
An Introduction

By Julian R. Ullmann; published by A.H. Wheeler & Co. Pvt Ltd, Allahabad; pages 268 (16 cm × 23 cm); soft cover.

This book imparts essential elementary knowledge and skills in logical design and assembly language programming for different levels (1-10) in computer technology. Chapter one explains radix conversation and binary arithmetic, instead of merely presenting a catalogue of procedural values. Chapter two concentrates on assembly language programming for Zilog Z80 at level 7. Chapters three and four emphasise cascaded and other repetitive circuits to strengthen the learners' intuitive grasp in preparation of these circuits. Chapter five provides an introduction to CPU design, while chapter six discusses input and output control, and briefly explains the use of microprocessor as a logic circuit component. And chapter seven further strengthens the knowledge about assembly language and machine code for Z80. Also provided are some vitally important text-related exercises in the first four chapters of this book.

Written in a simple manner, the book covers a wide range of topics to meet the needs of students on introductory computer study courses.

—R.G.



Handbook of Remote Control & Automation Techniques (second edition)

By John E. Cunningham and Delton T. Horn, published by Tab Books Inc., USA; pages 350 (13 cm × 21 cm); soft cover; price: US $ 13.95.

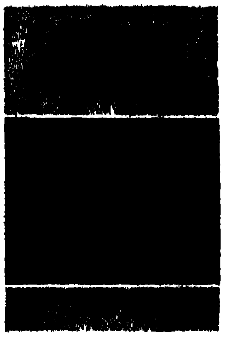
Electronic control systems for the home fascinate the hobbyist as they are both exciting and practical. Here is an ideal guide for those interested in the basic information on the development of remote control and automation technology.

Beginning with the fundamental principles, the book goes on to deal with devices like sensors, indicators, hydraulic systems and mechanical devices with which an average hobbyist may not be too familiar. Seven chapters are devoted to control devices of various types ranging from simple systems for controlling lights to systems which open doors by remote control.

The dramatic changes made in the field of microelectronics and use of computers as control devices have been particularly emphasised in the book.

The second edition has been considerably updated. Computer controlled systems and overcoming problems in interfacing the described systems with microprocessors have been described in detail. A new chapter explores the latest advances in robotics—including details for experimenters to design their own home-built robots!

—R.B.



Circuit Theory

By T.S.K.V. Iyer; published by Tata McGraw-Hill Publishing Co. Ltd, New Delhi; pages: 540 (16 cm × 23 cm); soft cover; price: Rs 39.

This book starts with fundamentals and leads to the RC active networks through the methods of analysis and synthesis. Chapters one to three deal with the concept of system function, natural frequency, poles and zeroes for simplifying circuit analysis. Chapter four lays down the basis for mesh-and-nodal analysis through graph theory towards a systematic analysis of larger circuits. In chapter six some network theories, including analogue and duals, are given to simplify circuit analysis, while chapter seven discusses some important properties of network function. Chapter eight focusses on linear electronic circuits by providing knowledge of two-port parameters for the better analysis of these circuits. Chapter ten is devoted to classical theory based on the concept of image impedance while chapter eleven is devoted towards modern filter theory and RC filters. The last chapter concentrates on stable variable method of analysis, including advanced topics in graph theory. Since this book is meant for engineering and physics students, examples to illustrate theory and a set of multiple choices questions and answers are provided for better understanding.

—R.G.

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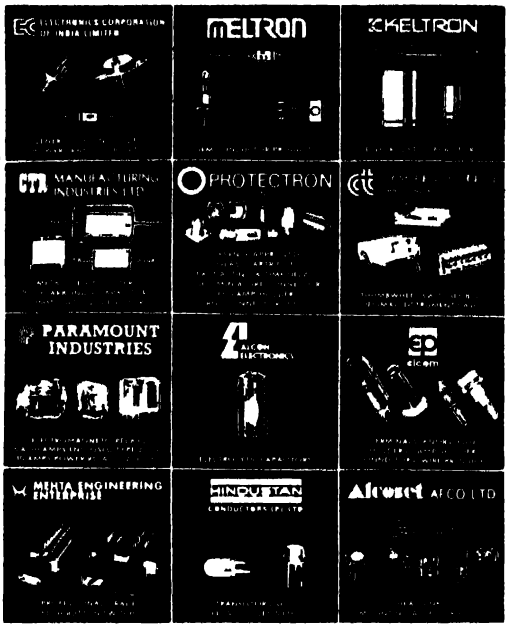

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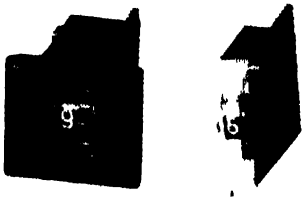

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Company Profiles

BEL introduces 35.5cm B&W TV picture tube

Bharat Electronics Limited (BEL) has modified its semi-automated TV picture tube plant to produce 35 5cm B&W tubes in a record time It expects to produce 200,000 to 400,000 TV picture tubes of 35 5cm size per annum This would be in addition to the production of 400,000 TV picture tubes in 51cm size

The requirements of black-and-white TV picture tubes in 35 5cm size was hitherto met by imports and another indigenous producers Decision to convert the second BEL plant was taken in December 1985 Within four months, the plant and equipment for 35 5cm tube production was got ready The loss of production for the switchcover from 51cm to 35 5cm was confined to one week only The semi-automated BEL plant is equipped with an industrial robot

BEL has total expertise in designing and setting-up of black-and-white TV picture tube plants In fact, it is already implementing an agreement with an entrepreneur for providing, on turnkey basis, a TV picture tube plant with capacity of 500,000 per annum It has also signed a memorandum of understanding with a state electronics development corporation for providing, on a turnkey basis, another plant of half-a-million capacity per annum

ITI Mankapur unit set for growth

The digital electronic switching systems unit of the Indian Telephone Industries (ITI), situated at Mankapur in Gonda district of eastern Uttar Pradesh, is a mammoth sophisticated electronic industry being set up at a cost of Rs 1800 million The unit entered its first phase during 1985-86 and produced 28,000 lines of digital electronic exchange equipment worth Rs 280 million

During the current year (1986-87), it has planned to produce 120,000 lines of equipment valued at Rs 1080 million By 1989-90, it will achieve full capacity of 500,000 lines per year with annual turnover of Rs 4000 million

This unit has been set up on the principle of vertical integration where most of the essential components are produced in-house [illegible]is approach was necessary, taking into consideration the extent of infrastructure facility available in the country at the time of conceptualising the project and the fact that since the factory was being set up in a green field area all critical items had to be planned for in-house production

The unit has been established in collaboration with CIT-Alcatel of France to manufacture E 10 B type of digital electronic exchanges, thereby laying the foundation for digitalisation of the communication network in India This unit is one among those which signify a major breakthrough in the technology upgradation efforts of the ITI currently underway

Gramophone Co. set for expansion

The Gramophone Company of India is offering on a rights basis equity shares worth Rs 22 4 million linked with 15 per cent secured redeemable debentures of Rs 100 each for Rs 57 6 million for augmenting its working capital and to fund its on-going modernisation programme

The company has decided to utilise its existing assets and manpower by combining modernisation with new activities The consumer electronic product division is being revamped for manufacturing audio equipment microcomponent music systems, car stereos and high quality cassettes It has tied up with Kenwood Ltd, UK for manufacture of domestic and industrial kitchen appliances The new products are expected to be introduced by October/November 1986

The woodwork division is being geared up for manufacturing TV cabinets and knocked-down modular furniture for the export market The engineering section is being tooled up for taking up manufacture of auto ancillaries and sophisticated motors Besides meeting in-house requirements, the printing and packaging division will undertake job work after installation of new offset machines

Avery India improves performance

Avery India Limited is to manufacture electronic baggage scales and automatic testing equipment at its Faridabad factory in the near future The company, which recently diversified into the field of electronic machines, is already manufacturing electronic weighing machines, platform scales and balances in collaboration with W and T Avery Limited, UK, and has already bagged orders worth Rs 10 million

The company has declared a dividend of 35 per cent for the year ended The dividend declared in the previous year was 30 per cent Sales turnover in 1985 rose to Rs 256 5 million from Rs 235 2 million in 1984, but profits declined marginally to Rs 63 million from Rs 67 5 million

HMT to set up corporate computer centre

The public sector Hindustan Machine Tools (HMT) is drawing up plans for establishing a corporate computer centre under its master modernisation and technology replacement programmes during the Seventh Plan

The proposed centre is part of the company s proposal to enhance computer application in manufacturing and material management, computer aided design (CAD) and computer aided manufacturing (CAM) During the Seventh Plan period, Rs 710 million would be spent on modernisation and replacement programmes as against Rs 518 4 million during the Sixth Plan

The company is undertaking replacement of machinery, wherever necessary, to take advantage of sophisticated control and precision capabilities It has already installed the latest machine centres for production flexibility

Hunt for HCL Collaborator

The selection of a foreign collaborator for the public sector Hindustan Cables Limited's (HCL) proposed fibre optic project is to be finalised within the next few weeks Several firms from Japan, Denmark and Britain have responded to HCL's bid to locate a suitable collaborator for the Rs 300-million project with a substantial foreign exchange component The project is expected to go into production in 1988-89.

In 1985-86 HCL earned a pre-tax profit of Rs 106.2 million (Rs 90.2 million in 1984-85) on a production of Rs 1665 9 million (Rs 1320 million) and sales of Rs 1790.2 million (Rs 1470 million). The targets for production, sales and pre-tax profit for the current year (1986-87) have been set at Rs 2603.2 million, Rs 2778.0 million and Rs 127 3 million respectively. This seems possible, since the new unit at Hyderabad to manufacture three million kilometres of jelly-filled cables has already started production and is expected to achieve 40 per cent capacity utilisation during the current year.

During the Seventh Plan period the company proposes to invest about Rs 1220 million on various schemes, mostly modernisation schemes, for which funds would be no problem.

Mahanagar Telephone to issue bonds

Mahanagar Telephone Nigam Ltd, which manages the telephone systems of Bombay and Delhi, has plans to offer seven-year public bonds of Rs 1000 each for cash at par for a total amount of Rs 3000 million around August next.

The Nigam might get the government's permission to give graded-priority to bondholders in the matter of sanction of new telephone connections.

The Nigam has, at present, assets worth depreciated value of Rs 12,000 million (Rs 8000 million in Bombay and Rs 4000 million in Delhi). The annual revenue is Rs 3000 million and the low return is mainly because of low telephone and other charges. While the charges have only tripled since 1960, the price index has shot up 14 fold, and the cost of equipment and staff salaries have gone up eight times each. Operations and maintenance account for only 20 per cent of the expenditure, and of this establishment charges total just 15 per cent.

The Nigam has a Rs 120-billion modernisation and expansion plan. It had sought this amount under the Seventh Plan but only Rs 40 billion has been approved and even of that Rs 30 billion is to be from internal resources.

DDC system knowhow for BHEL

Special purpose microprocessor based digital distributed control (DDC) system for power stations and industries will now be manufactured by Bharat Heavy Electricals Limited (BHEL).

A technical collaboration agreement was signed recently by Mr B.S. Samat, chairman and managing director, BHEL and Mr W. Roos, member, board of management, Brown Boveri, Switzerland.

With this the most modern and versatile state-of-the-art microprocessor based distributed digital control systems would be available to the Indian industry for automation in the entire range of applications from sub-system level to complete plant level. The scope of the agreement covers hardware and software design, engineering, manufacturing and supply of 'Procontrol' family of digital, decentralised control and monitoring systems.

BHEL has been supplying controls for various applications in power plants as well as in industry, based on the conventional method of controls. BHEL which had hitherto imported these controls will now manufacture them indigenously. The programmable control system is capable of offering a degree of accuracy, flexibility and versatility in their operations which is not possible by the existing system of hardwired controls, beside improved productivity and availability of plants.

Public issue by Fraternity

Fraternity Electronics Limited went public recently with an issue of 540,000 equity shares of Rs 10 each for cash at par.

The company is manufacturing audio magnetic tapes of international standards. It has also set up India's first magnetic video tape manufacturing unit equipped with the latest hi-tech machinery.

Usha Micro's bilingual computer

In keeping with the government's emphasis on using computers with bilingual capabilities, Usha Microprocess Controls Limited has developed just such a word processor called Devnagri.

The system has the flexibility of upgradation to take care of other languages as well. The software has been developed on the company's own Eagle PC—fully compatible with industry standard IBM PC, with a special effort to maintain its transportability to other systems also. The keyboard design makes operation simple for even the least skilled user.

Creation of Devnagri characters has been amply simplified. The word processor includes features like insert, delete, cursor movement, formatting of text, search/replace, printing etc. All standard features have been covered by Devnagri's flexible design.

The Devnagri word processor will be useful in creating bilingual documents such as letters, reservation charts, creating modifiable information for the masses, dictionary usage and use in government offices.

Large CTV from Weston

Weston Electroniks Limited recently launched the Centron VII—the largest colour television set available in the Indian market. The CTV was formally launched by Mr K. Sugiyana, director, Hitachi Sales Corporation, Japan, with which Weston has close cooperation.

The third generation set will have special features like auto-programme search, auto colour, full function remote control, hi-fi sound, anti-glare screen, besides all other functions of a normal CTV.

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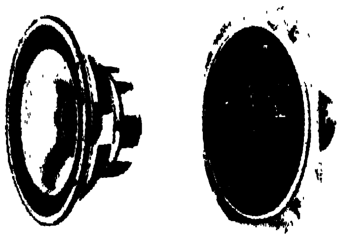

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BOMBAY
PRECIOUS ELECTRONICS CORPORATION
Chotani Building,
52, C Proctor Road,
Grant Road (East)
Bombay 400 007.

ELECTROMARK
304, Lotus House
33-A New Marine Lines
Bombay 400 020.

CALCUTTA
GENERAL RADIO COMPANY
6, Madan Street
Calcutta 700 072.

ELECTRONIC COMPONENTS & SYSTEMS
32, Ezra Street
Room No. 418, 4th Floor,
Calcutta 700 001.

DELHI
INDIAN TECHNOLOGICAL PRODUCTS
Flat No 305-306
Bldg No. 35-36,
Nehru Place, New Delhi 110 019.

DEWAN RADIOS
1681/28, Bhagirath Palace
Chandni Chowk,
Delhi 110 006

HYDERABAD
SHILPA ELECTRONICS
107, Parklane
Secunderabad 500 003.

INDORE
ATLAS SALES AGENCIES
18/2 Siyaganj
Indore 452 001

JAIPUR
EL-TRONICS
87, A Dhuleshwar Garden
Jaipur 302 001.

KANPUR
EVERON ASSOCIATES
18/179, 1st Floor,
Opp. Phool Bagh, The Mall
Kanpur 208 001.

KOTA
CHAMBAL ELECTRONICS
4C 16 Housing Board colony
Talwadi, Kota 324 005

LUCKNOW
ARTEK ENTERPRISES
14, Cantonment Road
Opp. Shilpi Cinema
Lucknow 226 001

MADRAS
TEXONIC INSTRUMENTS
Post Box No. 3746
9, Athipattan street
Mount Road, Madras 600 002

PRECIOUS ELECTRONICS CORPORATION
9, Athipattan street
Mount Road, Madras 600 002.

POONA
NAGESH ELECTRIC & ELECTRONICS CORP.
476, Budhwar Peth
Pune 411 002

TRIO RADIO & ELECTRONIC
CORPORATION
466, Budhwar Peth
Pune 411 002

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- Many other important topics

For registration please contact:

Mr. V.P. Leekha
Conference Co-ordinator
Thapar Engineering College Alumni – Delhi
Thapar House, 124 Janpath, New Delhi 110 001
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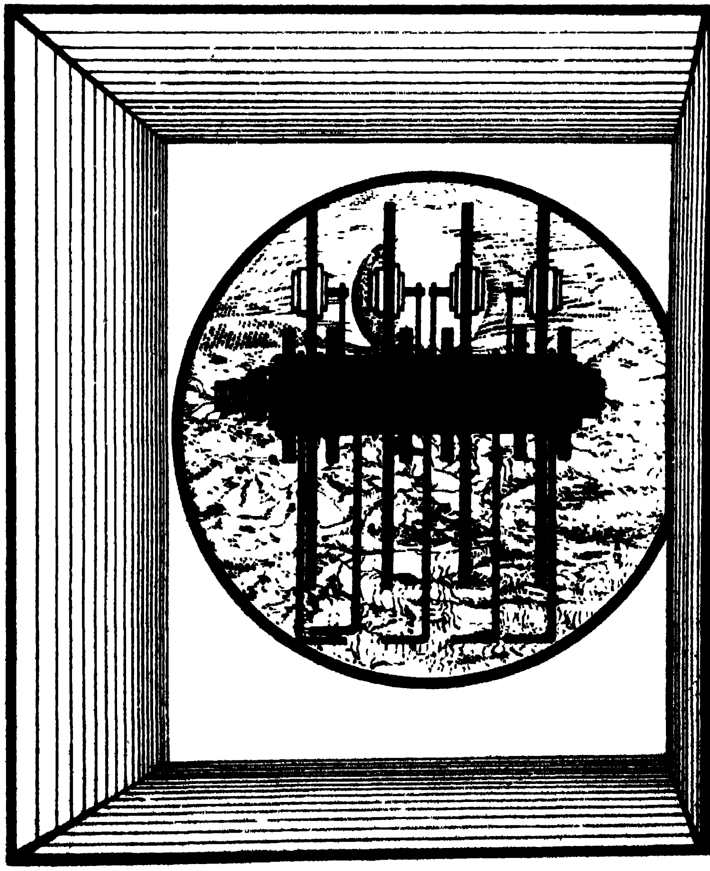

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LICENCES AND LETTERS OF INTENT

The following licences and letters of intent were issued to electronics firms under the Industries (Development & Regulation) Act, 1951 during the month of February 1986.

Name & Address of the Applicant and Location of the Undertaking (1)	*Date & Type of Licence* (2)	*Article* (3)	*Quantity per Annum* (4)
LICENCES			
Dynamic Enterprises Pvt Ltd 181/33 Industrial Area, Phase-I Chandigarh (Chandigarh)	3.2 86 (NU)	Magnetic recording/playback and erasing heads	1.2 million nos
The Meghalaya Indl Dev Corpn Ltd 'Kismat', Upland Road Laitum Khrah, Shillong 793003 (Khasi Hills-Meghalaya)	4.2.86 (NU)	Tantalum capacitors	5 million nos.
Morris Electronics Ltd Bhosari Industrial Estate, Pune 411026 (Pune-Maharashtra)	5.2.86 (SE)	1 Hard ferrites 2 Soft ferrites	2500 tonnes 1000 tonnes (after expansion)
P Palaniappan 235 Nint Street, Madras 600003 (Chingleput-Tamil Nadu)	12 2.86 (NU)	Metallised plastic films (capacitor grade)	180 tonnes
Indian Computer Software Co Ltd 808 Siddhartha, 96 Nehru Place New Delhi 110019 (Madras-Tamil Nadu)	13.2.86 (COB)	Computer peripherals, dot matrix printers and CRT display monitors	10 million
Jyoti Limited Industrial Area P O Chemical Industries Vadodara 390003 (Vadodara-Gujarat)	21.2.86 (NA)	Programmable logic control systems	75 nos
Pelco Electronics & Electricals Ltd Shivsagar Estate, Block 'A' Dr Annie Besant Road Bombay 400018 (Agrahara-Karnataka)	25.2.86 (NU)	1. High speed character printers 2 Mini floppy disc drives 3. Low profile electronics keyboards	1000 nos. 2000 nos. 1500 nos.
Pelco Electronics and Electricals Ltd Shivsagar Estate, Block 'A' Dr Annie Besant Road Bombay 400018 (Pune-Maharashtra)	26.2.86 (NA)	Single-sided printed circuit boards	30,000 sq m
Uptron India Ltd 10 Ashok Marg, Lucknow 226001 (Lucknow-Uttar Pradesh)	28.2 86 (NA)	Line output transformers for colour TVs	300,000 nos
LETTERS OF INTENT			
Narendra Kumar Patni 42-A Jolly Maker, Apartment-I Cuffe Parade, Colaba Bombay 400005 (Ghaziabad-Uttar Pradesh)	4 2.86 (NU)	Minicomputer/microprocessor based systems	Rs 200 million
Jyoti Limited Industrial Area P.O. Chemical Industries Vadodara 390003, Gujarat (Vadodara-Gujarat)	4.2.86 (NA)	Minicomputer/microprocessor based systems	Rs 20 million
Jawahar Kandhari 29 Vasantanagar, 7th Cross Bangalore 560052 (Bangalore-Karnataka)	4.2.86 (NU)	Minicomputer/microprocessor based systems	100 million
Sunderam Clayton Ltd 'Jayalakshmi Estates' 8 Haddows Road Madras (Karnataka)	14.2.86 (NU)	1. Uninterruptible power supply systems 2. Switch mode power supply systems	21,000 nos. 54,000 nos.
Mahinder Singh Thakural C/o Dr N.L Hingorani R.J Consultants Pvt Ltd 3A Meher House, 1st Floor 15 Cawasji Patel Street Fort, Bombay 400001 (Ghaziabad-Uttar Pradesh)	14.2.86 (NU)	1. Minicomputer/microprocessor based systems 2 Computer peripherals 3 Electronic calculators	Rs 100 million Rs 60 million 100,000 nos.
Norsk Data (India) Pvt Ltd Plot No 47, Developed Plots for Electrical & Electronics Industries Seevaram Village, Madras (Chingleput-Tamil Nadu)	21 2 86 (NU)	Minicomputer/microprocessor based systems	Rs 100 million
Bhoruka Data Products Pro Bhoruka Drum & Allied Trans Industries Pvt Ltd 1010 Raheja Chambers Nariman Point Bombay 400021 (Thane-Maharashtra)	21 2.86 (NU)	1 Computer peripherals (floppy disc drives and printers) 2 CRT data display monitors	Rs 50 million 5000 nos.
Zoom Electronics (India) Ltd D-7 Knollswood, Shimla Himachal Pradesh (Any backward Distt-Himachal Pradesh)	21 2.86 (NU)	1 Portable X-ray machines 2 Digital blood pressure monitors 3. Digital weighing scales 4. ECG machines	500 nos. 5000 nos. 5000 nos. 1000 nos.
ITL Computers (P) Ltd 86 Srinagar Colony Hyderabad 500873 (Medak-Andhra Pradesh)	21.2.86 (NA)	1. Minicomputer/microprocessor based systems 2 Robotic systems	Rs 100 million 500 nos
Hindustan Brown Boveri Ltd Brown Boveri House Race Course Circle Vadodara 390007 (Mysore-Karnataka)	21.2 86 (NA)	Facsimile equipment	2000 nos.
Flovel Private Limited 13/1 Mathura Road Faridabad 121003 Haryana (Faridabad Haryana)	21.2.86 (NA)	Electronic governors for prime movers	1500 nos.
Ambalal Sarabhai Enterprises Ltd (Unit Systronics) Wadi Wadi, Vadodara 390007 (Ahmedabad-Gujarat)	24.2.86 (NA)	Recording gas chromotographs	150 nos
The Enfield India Limited 29 Eldams Road, Madras 600018 (North Arcot-Tamil Nadu)	24.2.86 (NU)	1. Black-and-white TV receivers 2. Colour TV receiver sets 3. Mono/stereo-radio-cum-cassette players/three-in-ones other than those reserved for the small-scale sector	5000 nos. 50,000 nos. 10,000 nos.
Kody Elcot Ltd 1/8th East Street, Kamarajnagar Thiruvanmiyur, Madras 600041 (Chingleput-Tamil Nadu)	27.2.86 (NU)	1. Defibrillators 2. Cardiac monitors and patient monitoring systems 3. Respirators	150 nos. 150 nos. 150 nos.
Belwal Electronics Ltd 16 Duplex Oberoi Apartments 2 Sham Nath Marg, Delhi 110054 (Nainital-Uttar Pradesh)	28.2.86 (NU)	Facsimile terminals	2000 nos.

Name & Address of the Applicant and Location of the Undertaking (1)	Date & Type of Licence (2)	Article (3)	Quantity per Annum (4)
Punjab State Electronics Development & Production Corpn Ltd Bank of India Building, (2nd Floor) Sector-17B, Chandigarh (Ropar-Punjab)	28 2 86 (NU)	1 High powered X-ray machines 2 X-ray therapy simulators 3 Linear accelerators (4 MEV) 4 Gama cameras	19 nos 12 nos 12 nos 12 nos
Devilog Systems (India) 65 H. Siddiah Road Bangalore 560002 (Bangalore-Karnataka)	28 2.86 (NU)	Computer peripherals	Rs 60 million
Kerala State Industrial Development Corpn Ltd T C No XI/239, Keston Road Kawdiar, Trivandrum 695003 (Alleppey-Kerala)	28.2 86 (NU)	Metallised paper	1000 tonnes

LICENCES AND LETTERS OF INTENT CANCELLED/LAPSED

Name of the Undertaking (Location)	L/IL Dated	Article
LICENCES		
Televista Electronics Pvt Ltd New Delhi (Maharashtra)	31 12 83	Colour TV receivers
Rao Insulating Co Pvt Ltd Bangalore (Karnataka)	25 6 83	Monochrome TV receivers
Unitron Ltd Uttar Pradesh (Haryana)	25 1 85	Black-and-white and colour TV receiver sets
LETTERS OF INTENT		
Yughalakshmi Video Pondicherry (Haryana)	29 12 83	Black-and-white TV receivers etc
Cee Kay Associates New Delhi (Uttar Pradesh)	20 12 83	Colour television sets
Vijay Krishna Lakhanpal New Delhi (Goa, Daman & Diu)	12 3 85	Colour TV receivers
CTR Manufacturing Industries Ltd Pune (Maharashtra)	13.8.84	Cermet potentiometers
S V. Padmakumar Pollachi (Tamil Nadu)	24 2.84	Electronic typewriters
Home Vision System Pvt Ltd New Delhi (Rajasthan)	13 12.84	Video projectors
R. Vijay Kumar C/o Vikram Enterprises Madras (Tamil Nadu)	27 12.84	VCR/VCP and video projectors
Kinetic Engineering Pune (Madhya Pradesh)	13 12.84	Video projection TVs etc
Mohan Vimal New Delhi (Haryana)	27 12.84	Colour projection TVs
Televista Electronics Pvt Ltd New Delhi (Uttar Pradesh)	12.11 84	Large-screen TV projection systems
Rajaram Ramachandran Bangalore (Tamil Nadu)	22.9.84	VCR/VCP and video projectors
C H Krishnamurthi Rao Pondicherry (Pondicherry)	27.12.84	Video/TV colour projection systems and colour TVs
Meenakshi Electronics Ltd Kanpur (Uttar Pradesh)	21.7.84	Colour TV sets
PCS Data Products Pvt Ltd Bombay (Madhya Pradesh)	3 12 84	Colour TV sets
Dr C L Chandok Solapur (Madhya Pradesh)	13 12 84	Colour TV sets
M L Tandon Bombay (Karnataka)	24 7 84	CTV receiver sets
Vishnudas Ranglal Bhutada Maharashtra (Madhya Pradesh)	27 12 84	CTV receiver sets
Sarine Electronics Pvt Ltd New Delhi (Himachal Pradesh)	16 7 84	Colour and black-and-white TV sets
Dinesh Jain Cachar (Assam)	27.12.84	Colour TV sets

LIST OF UNITS APPROVED IN THE ORGANISED SECTOR FOR THE MANUFACTURE OF COMPUTERS

Name of the Unit 1	Item 2	Capacity 3
Ambalal Sarabhai Enterprises Ltd Vadodara	Minicomputer/microprocessor based systems	Rs 60 million/annum
Andhra Pradesh Electronics Dev Corpn Ltd Hyderabad	1 Shared display systems 2 Data acquisition systems	20 systems/annum 20 systems/annum
Anika Computers Pvt Ltd New Delhi	Intelligent/interactive graphic terminals	100 systems/annum
Aptex Computers Pvt Ltd Bombay	1 Personal computers 2 Data acquisition systems	5000 systems/annum 5000 systems/annum
ASEA Ltd Bombay	Minicomputer/microprocessor based systems	Rs 20 million/annum
Ashok Kumar Verma Delhi	Minicomputer/microprocessor based systems	Rs 100 million/annum
Auto Control Pvt Ltd New Delhi	Minicomputer/microprocessor based systems	Rs 60 million/annum
Avtar Singh Sethi New Delhi	Minicomputer/microprocessor based systems	Rs 60 million/annum
B Biswas New Delhi	Minicomputer/microprocessor based systems	Rs 100 million/annum
Basu Joshi Vetteth Madras	Minicomputer/microprocessor based systems	Rs 60 million/annum
Bharat Heavy Electricals Ltd Bombay	Minicomputer/microprocessor based systems	Rs 350 million/annum
Bihar State Electronics Dev Corpn Ltd Patna	Minicomputer/microprocessor based systems	Rs 65 million/annum
Bush India Ltd Bombay	Minicomputer/microprocessor based systems	Rs 100 million/annum
B K Aggarwal Houston	Minicomputer/microprocessor based systems	Rs 200 million/annum
Blue Star Ltd Bombay	Minicomputer/microprocessor based systems	Rs 300 million/annum
CHK Data Systems Pvt Ltd Madras	Microprocessor based measure, control systems	Rs 20 million/annum
Chowgule & Co. Pvt Ltd Goa	Minicomputer/microprocessor based systems	Rs 200 million/annum
Computronics (India) Ltd New Delhi	Minicomputer/microprocessor based systems	Rs 20 million/annum
Continental Device India Ltd	Minicomputer/microprocessor	Rs 200 million/annum

Name of the Unit 1	*Item* 2	*Capacity* 3
New Delhi	based systems	
CRID Ltd Bhubaneswar	Minicomputer/microprocessor based systems, passbook printers proof encoders	Rs 60 million/annum
Crompton Greaves Bombay	Programmable controllers	Rs 40 million/annum
D S Nanda New Delhi	Minicomputer/microprocessor based systems	Rs 100 million/annum
DCM Data Products New Delhi	1 Data loggers	100 nos/annum
	2 Minicomputer/microprocessor based systems	Rs 115 million/annum
	3 Data entry systems	400 nos/annum
	4 CRT data/graphic display terminals	4000 nos/annum
Debikay Systems Ltd New Delhi	Word processors	20,000 nos/annum
Dittakavi Ashoku New Delhi	Minicomputer/microprocessor based systems	Rs 100 million/annum
Lacoms Controls (India) Pvt Ltd New Delhi	Process control/microprocessor based process instruments	Rs 150 million/annum
Electronic Research Pvt Ltd Bangalore	Minicomputer/microprocessor based systems	Rs 200 million/annum
Electronic Systems Punjab Ltd Chandigarh	1 Minicomputer/microprocessor based systems	Rs 150 million/annum
	2 Data aquisition systems	20 systems/annum
	3 Colour graphic terminals	500 systems/annum
Electronics Corporation of India Ltd Hyderabad	1 Analogue computer systems	35
	2 Digital computer systems	50
	3 Minicomputer/microprocessor based systems	250
	4 Colour graphic/image process display terminals	100
	5 Data acquisition systems	Rs 30 million/annum
Electronics Corpn of Tamilnadu Ltd Madras	Minicomputers	50 systems/annum
Emesh Micro Computer International Ltd Chandigarh	Microcomputing devices	10,000 nos/annum
General Electronics	Minicomputer/microprocessor based systems	Rs 20 million/annum
Golden Computers Pvt Ltd Bombay	Microprocessor based systems	50 systems/annum
Goodwill Electronics & Engg Co Pvt Ltd New Delhi	Minicomputer/microprocessor based systems	Rs 60 million/annum
Gujarat Communication & Electronics Ltd Vadodara	Minicomputer/microprocessor based systems	Rs 30 million/annum
Hindustan Brown Boveri Ltd Vadodara	Minicomputer/microprocessor based systems	Rs 100 million/annum
Hindustan Computers Ltd New Delhi	1 Minicomputer/microprocessor based systems	Rs 230 million/annum
	2 Accounting invoicing machines	620
Hinditron Computer Systems & Consultant (P) Ltd Bombay	Digital computer systems	100 systems/annum
Incomnet India Ltd Mohali	Minicomputer/microprocessor based systems	Rs 60 million/annum
Ind Promotion & Investment Corpn of Orissa Ltd Bhubaneshwar	Minicomputer/microprocessor based systems	Rs 20 million/annum
Indian Duplicators Co Ltd Calcutta	Word processing systems	3000 systems/annum
Indo-Swing Ltd Hyderabad	Minicomputer/microprocessor based systems	Rs 100 million/annum
Infotech Ltd Madras	Minicomputer/microprocessor based systems	Rs 60 million/annum
Instrumentation Ltd Kota	1 Data acquisition systems	Rs 60 million/annum
	2 Microprocessor based systems	Rs 30 million/annum
International Computers India Mfg Ltd Pune	1 2904 computer systems	100 systems/annum
	2 Minicomputer/microprocessor based systems	Rs 240 million/annum
J&K State Indl Dev Corpn Ltd Srinagar	Minicomputer/microprocessor based systems	Rs 100 million/annum
Jagdish Rai Kappal New Delhi	Microprocessor line of process control instruments	Rs 150 million/annum
Jai Ram Chand Moorjani Bombay	Time sharing terminals	5000 systems/annum
Kamal Electronics & Engg Ltd Vadodara	Microprocessor based systems	Rs 30 million/annum
Karnataka State Electronics Dev Corpn Ltd Bangalore	Minicomputer/microprocessor based systems	Rs 100 million/annum
Kartar Singh Thakral Bombay	Minicomputer/microprocessor based systems	Rs 30 million/annum
Kirloskar Electric Co Ltd Bangalore	1 Winchester disc drives	15,000 nos/annum
	2 Micro/minicomputers	Rs 100 million/annum
Kerala State Electronics Dev Corpn Ltd Trivandrum	Minicomputer/microprocessor based systems	Rs 400 million/annum
Kothari Electronics & Industries Ltd Madras	Minicomputer/microprocessor based systems	Rs 300 million
Lattandu Mahapatra USA	Minicomputer/microprocessor based systems	Rs 200 million/annum
M R Narayanan Trivandrum	1 Daisy wheel printers	Rs 50 million/annum
	2 Microprocessor based terminal converters	Rs 50 million/annum
Machinery Mfs Corpn Ltd Bangalore	Minicomputer/microprocessor based systems	250 systems/annum
Macmillan India Ltd Bangalore	Minicomputer/microprocessor based systems	Rs 100 million/annum
Manchar Lal Tondon Bombay	Minicomputer/microprocessor based systems	Rs 100 million/annum
Meltron Instrumentation Ltd Bombay	1 Minicomputer/microprocessor based systems	Rs 20 million/annum
	2 Minicomputer, graphic/scientific	15 systems/annum
	3 Data acquisition systems	15 systems/annum
Methodex Systems Pvt Ltd New Delhi	Minicomputer/microprocessor based systems	Rs 30 million/annum
Milan Electronics (P) Ltd Noida	Minicomputer/microprocessor based systems	Rs 95 million/annum
Minicomp Pvt Ltd Bombay	Minicomputer/microprocessor based systems	Rs 20 million/annum
Modi Xerox Ltd Rampur	Minicomputer/microprocessor based systems	Rs 300 million/annum
MP State Industrial EDC Ltd Bhopal	Minicomputer/microprocessor based systems	Rs 140 million/annum
Multitech International Ltd New Delhi	Minicomputer/microprocessor based systems	Rs 200 million/annum
Murphy India Ltd Thane	Minicomputer/microprocessor based systems	Rs 20 million/annum
Negolice Ltd New Delhi	Minicomputer/microprocessor based systems	Rs 65 million/annum
OMC Computers Ltd Pattancheru	Minicomputer/microprocessor based systems	Rs 60 million/annum
P L Raghu Ram Secunderabad	Minicomputer/microprocessor based systems	Rs 60 million/annum
Pramod Kumar Agarwal Bombay	Minicomputer/microprocessor based systems	Rs 60 million/annum

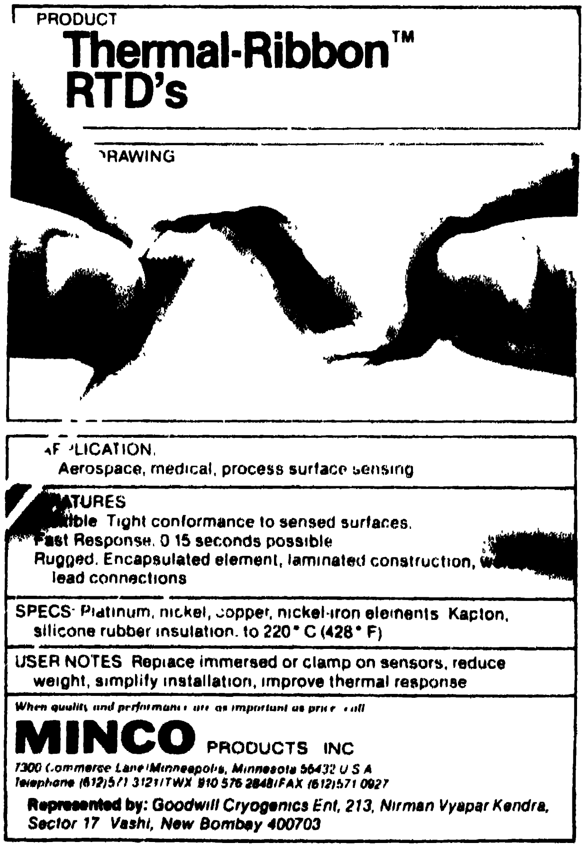
Name of the Unit	Item	Capacity
1	2	3
Peico Electronics & Electricals Ltd Calcutta	Minicomputer/microprocessor based systems	Rs 20 million/annum
Prabhat K Andlagh New Delhi	Minicomputer/microprocessor based systems	Rs 60 million/annum
Prakash Ambagaonkar USA	Controllers for microcomputers	
Prime Home Computers Pvt Ltd New Delhi	Minicomputer/microprocessor based systems	Rs 50 million/annum
Punjab State Electronics Dev & Production Ltd Chandigarh	Minicomputer/microprocessor based systems	Rs 200 million/annum
RCC Plastics Pvt Ltd Bombay	Minicomputer/microprocessor based systems	Rs 200 million/annum
Rakesh Gandhi New Delhi	Minicomputer/microprocessor based systems	Rs 200 million/annum
Rishi Electronics Ltd New Delhi	Minicomputer/microprocessor based systems	Rs 20 million/annum
Sanag Micromotion Pvt Ltd	Minicomputer/microprocessor based systems	Rs 50 million/annum
Sandeep Engineers Pvt Ltd New Delhi	Minicomputer/microprocessor based systems	Rs 100 million/annum
Sandur Electronic Controls & Auto Pvt Ltd Bangalore	Data acquisition monitoring systems	50 systems/annum
Semiconductors Ltd Bombay	Computers	2000 systems/annum
Shourie Copier Pvt Ltd New Delhi	Word processors	5000 systems/annum
Siemens India Ltd Bombay	Data acquisition logging control systems	50 systems/annum
Sigma Engineers Pune	Minicomputer/microprocessor based systems	5 systems/annum
Soumag Electronics Ltd Madras	Microprocessor based information display systems	200 systems/annum
Suresh Srivastava New Delhi	Microprocessor based control instrumentation	Rs 100 million/annum
T S Grewal New Delhi	Minicomputer/microprocessor based systems	Rs 100 million/annum
Tata Burroughs Ltd Bombay	Minicomputer microprocessor based systems	
The General Electric Co of India Ltd Calcutta	Minicomputer/microprocessor based systems	Rs 20 million/annum
The National Radio & Electronics Co Ltd Bombay	1 Data acquisition control systems 2. Minicomputer/microprocessor based systems	17 systems/annum Rs 60 million/annum
UP Electronics Corpn Lucknow	1 Keys to disc entry systems 2 Intelligent terminals 3 Operator interface stations	75 150 1000
Unitron Ltd Faridabad	Minicomputer/microprocessor based systems	Rs 20 million/annum
Uptron Digital Systems Lucknow	1 Data loggers for remote telemetry 2 Keys to disc data entry systems 3 Minicomputer/microprocessor based systems	15 systems/annum 150 systems/annum 60 million/annum
Usha Microprocess Controls Ltd New Delhi	Minicomputer/microprocessor based systems	Rs 60 million/annum
Vishy Harihara UK	Minicomputer/microprocessor based systems	Rs 200 million/annum
Webel Business Machines Ltd Calcutta	Computer based electronics industrial monitoring and control systems	50 systems/annum
Webel Computers Ltd Calcutta	Minicomputer/microprocessor based systems	Rs 20 million/annum
Western India Electors Ltd Pune	Data retrieval terminals	2500 nos/annum
Wipro Information Technology Ltd Bangalore	Minicomputer microprocessor based systems	Rs 400 million annum

Source From questions answered by the minister of state for Science and Technology, Mr Shivraj V Patil in the Lok Sabha

ITEM-WISE PRODUCTION OF ELECTRONIC WATCHES FOR THE YEAR 1985

Name of the Manufacturer	Item details	Quantity
Electronics Corporation of Tamilnadu Ltd Madras	Digital electronic watches	6096
Hindustan Machine Tools Bangalore	Quartz watches	163,000
Hyderabad Allwyn Ltd Hyderabad	Quartz analogue watches	94 022
Keltron Crystals Ltd Cannanore	Digital electronic watches	3896
RIICO (Watch Assembly) Ajmer	Digital electronic watches	3708

Source From questions answered by minister of state for Science and Technology Mr Shivraj V Patil, in the Lok Sabha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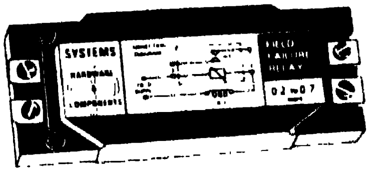

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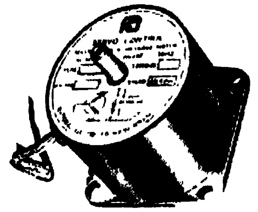

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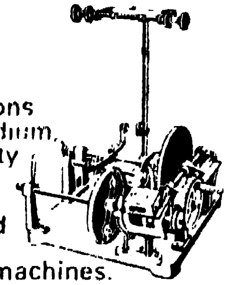

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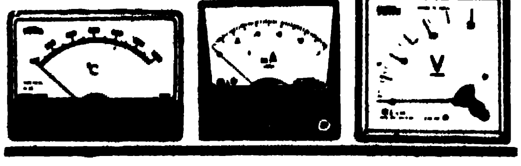

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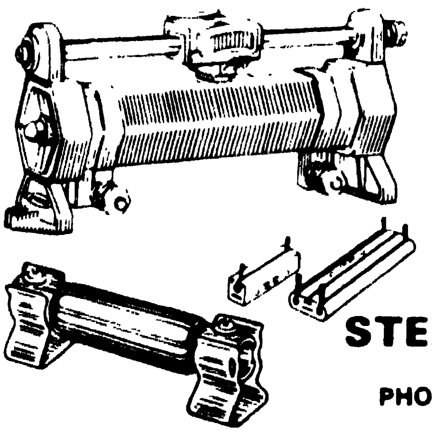

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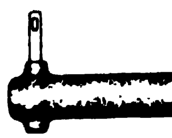

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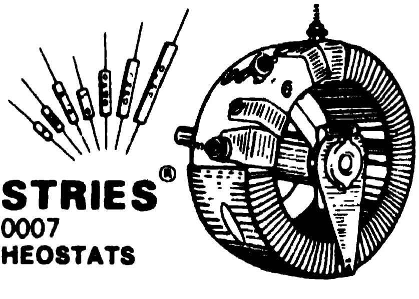

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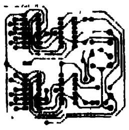

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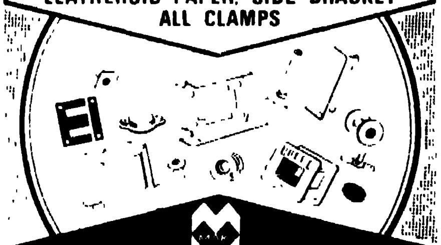

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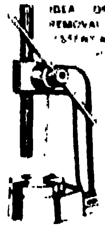

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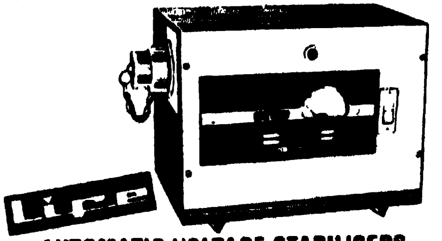

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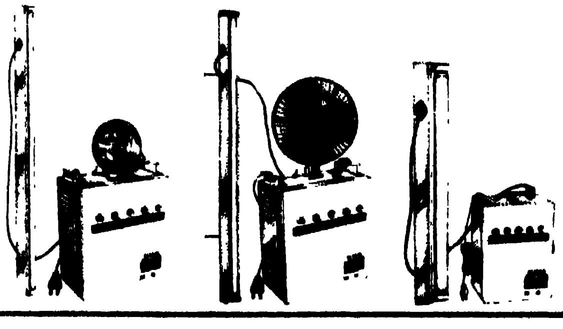

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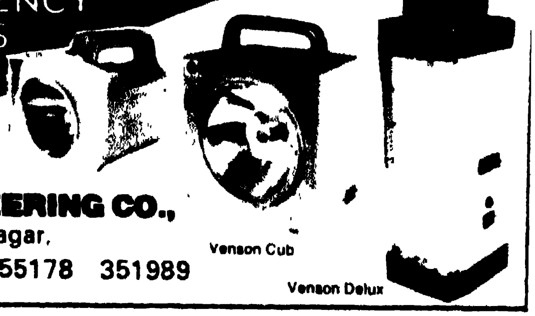

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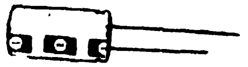

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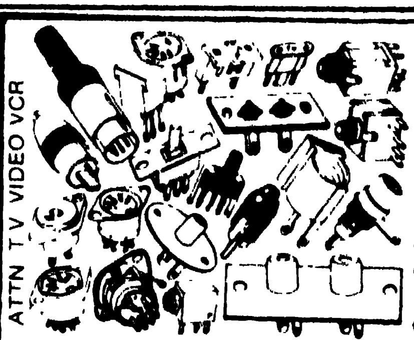

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ASE Ltd (Systronics)	50
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Alfa Products	52
Allied Publishers	45
Amar Radio Corporation	66
Ampi Agencies	28
Aradhana Electronics	90
Associated Electrical Agencies	7
B P B Publications	10
Balaji Engineering	52
Brisk Electro Sales	50
CTR Manufacturing	22, 104
Cahners Expositions Group	84
Champion Electronics	98
Crescent Agencies	34
Deki Electronics	85
Desco Electronic	91
Digital Promoters	15
Dominion Radios	32, 66
Electro Systems Associates	42
Electronic Instruments & Controls	6
Elnova	43
Geeta Monitors	48
Glolite Electricals	21
Goodwill Crogenics	109
HSIN Semiconductor, Singapore	21
Hindustan Conductors	97
ITT, West Germany	IV Cover
Inde Associates	9, 12
Indian Engineering	91
Integral Systems	100
J J Electronics	66
J.R Controls	100
Jyoti Electronics	65
K.L. Industries	5, 42
Karnataka State Electronics	8
Kwality Electricals	48
Lakshmi Electrical Control	92
Leader Electronics, Delhi	20
Leader Electronics, Japan	58
M.U. Electronics	45
Marketing & Management Services	6
Meco Instruments	79
Motwane Manufacturing	44
Murugappa Electronics	33, 101
Navnidhi Electronics	29
Nippon Denshi, Japan	45
O/E/N Connectors	86
PEC Components Manufacturing	71
PLA Electro Appliances	60
Pal Industries	85
Plastart	20
Poonam Industrial Research	3
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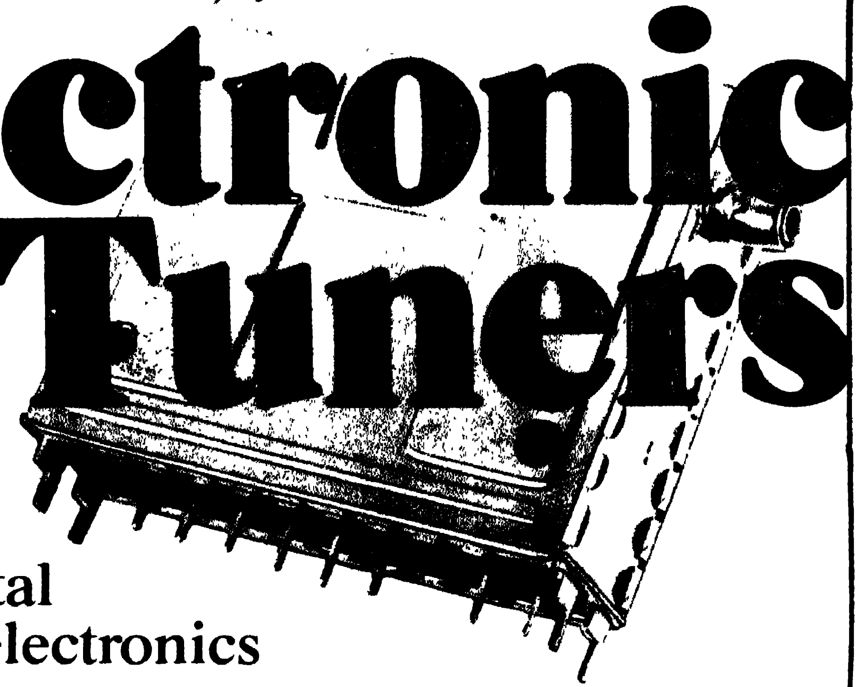

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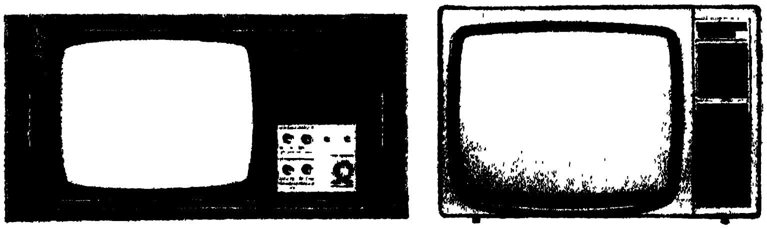

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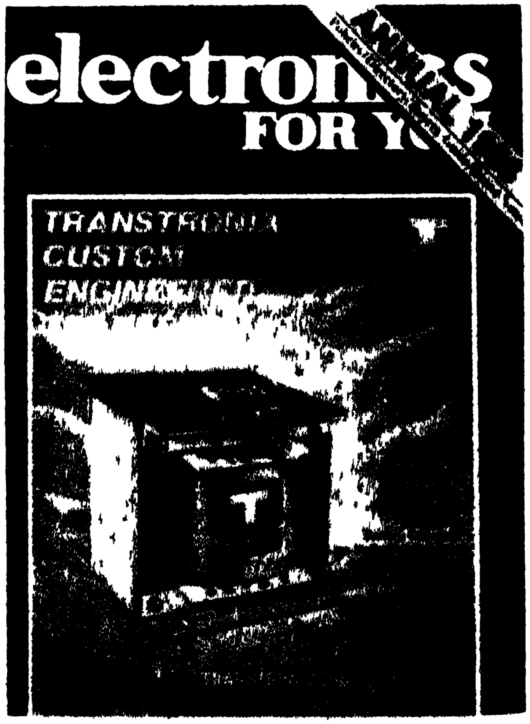

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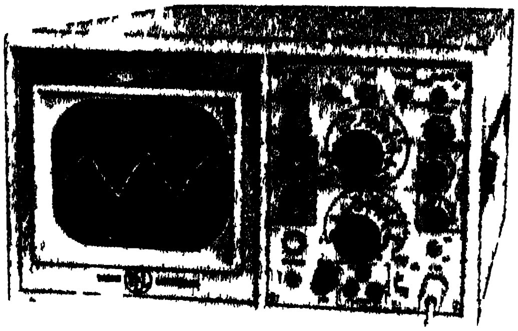

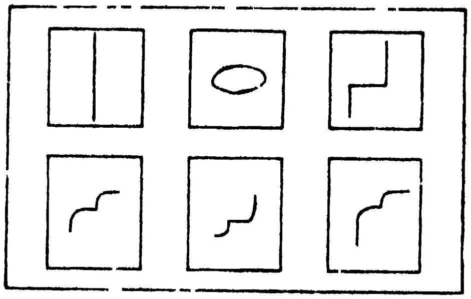

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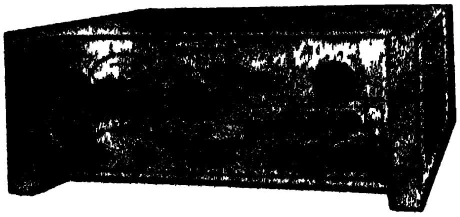

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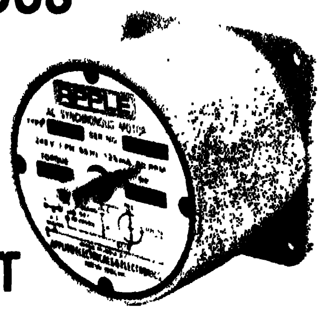

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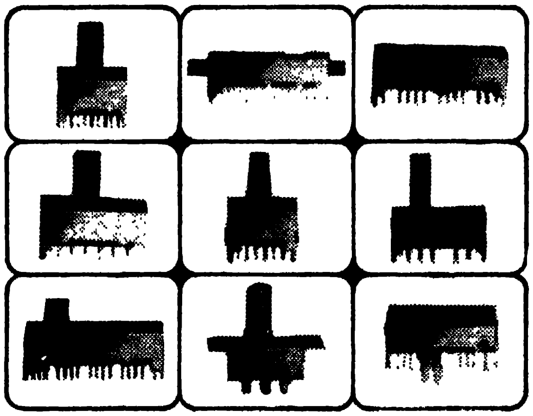

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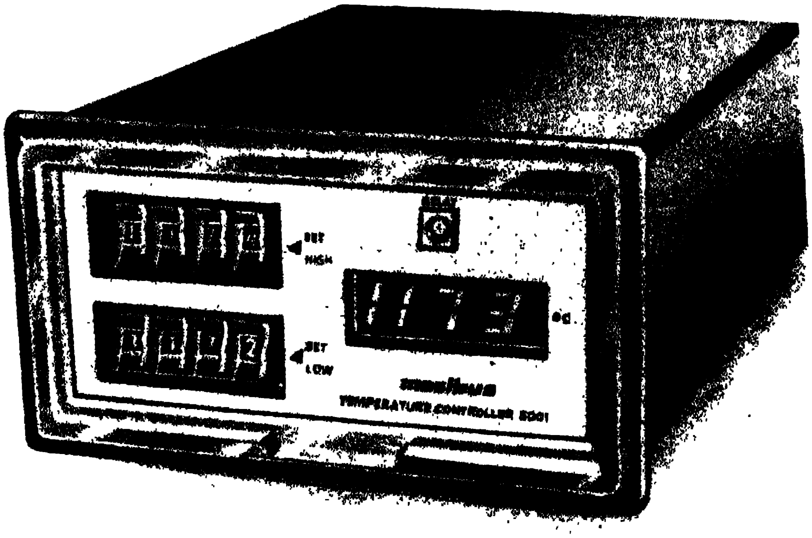

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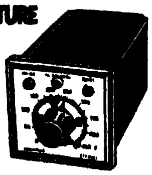

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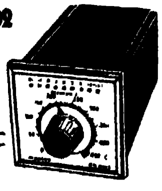

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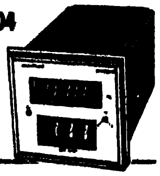

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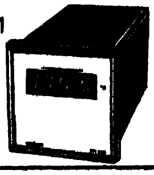

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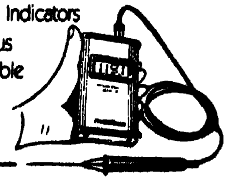

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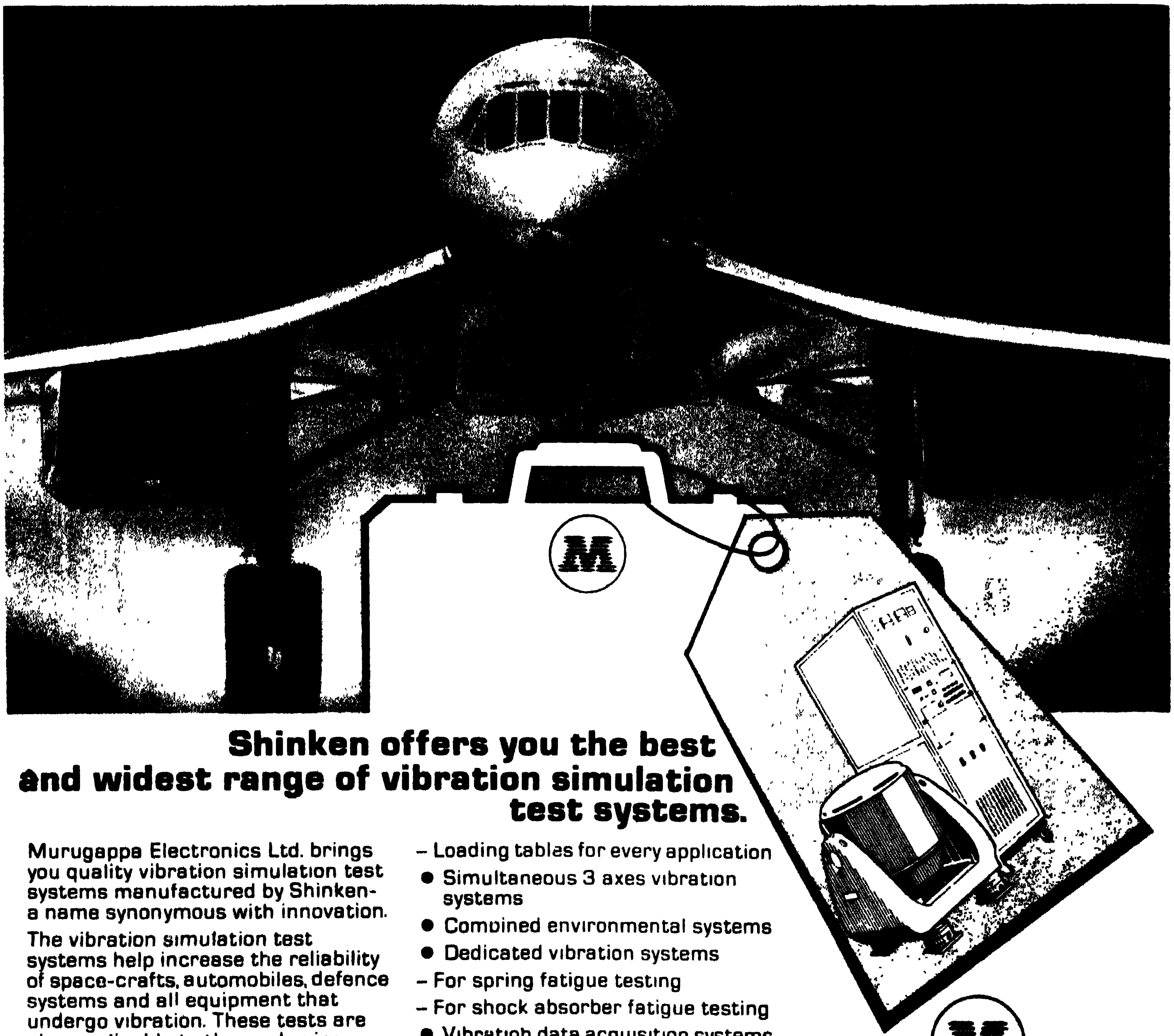

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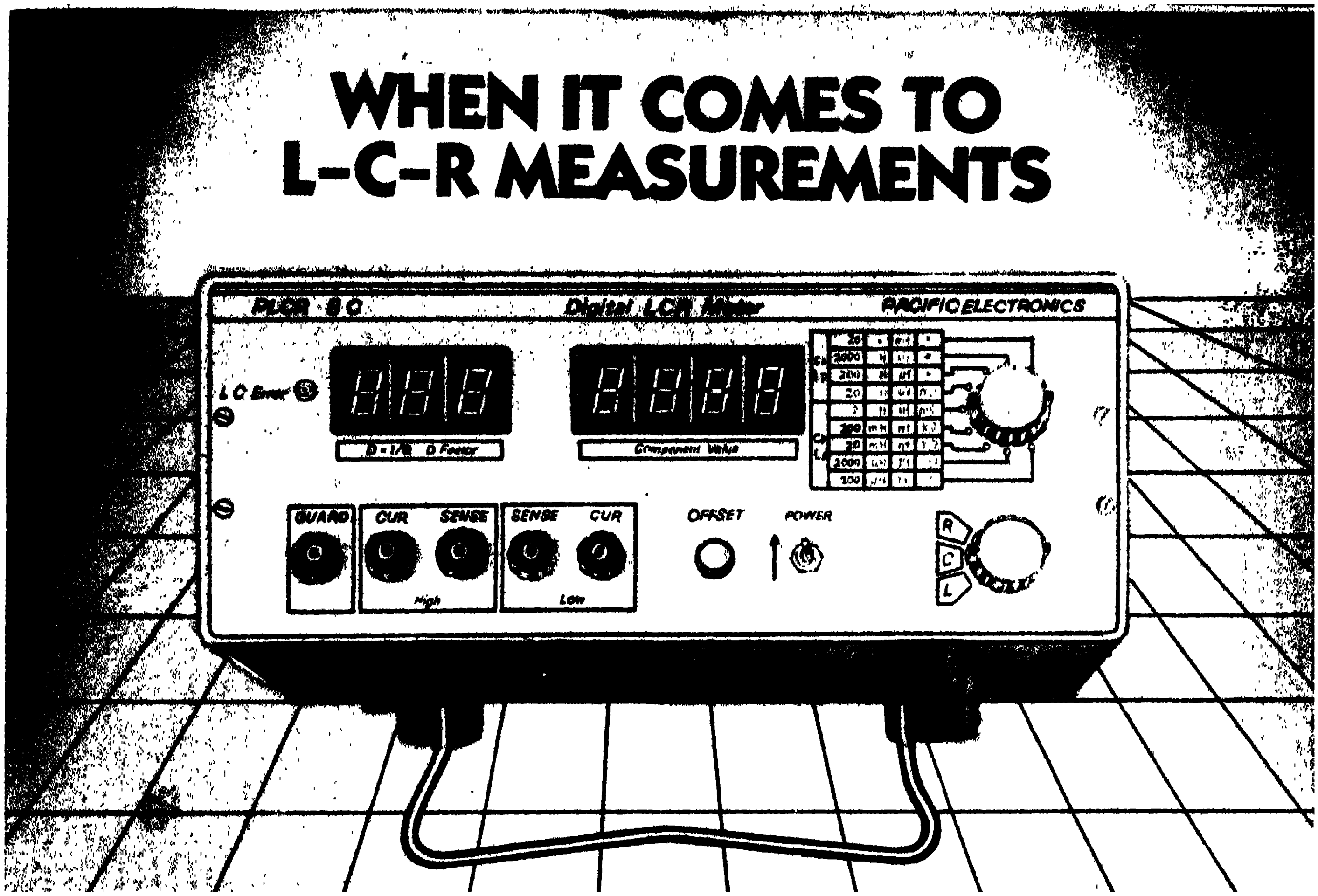

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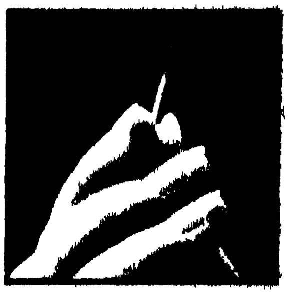
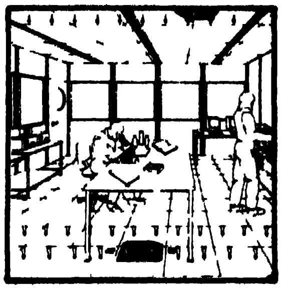


24 Fibre Optic transmission technology has developed rapidly over the last decade and a half, completely revolutionising the communication processes Though still in its nascent stage, the progress it has made has exceeded the expectations of even the most optimistic forecasts An introduction to this fascinating technology

—S.K Puranik



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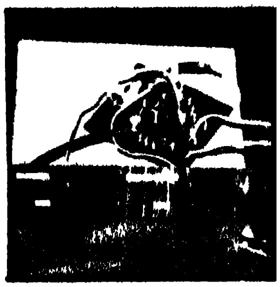
35 Once deemed a luxury, clean rooms have today become the precision tool of sophisticated electronics technology Even a particle of a few microns can affect the correct functioning of a delicate mechanism This article defines the clean rooms and discusses the design considerations to be kept in mind

—K. Barua

Sound Activated Flash for 'Stop Action' Photography



77 For budding photographers as well as hobbyists, here is a project to capture different stages of such transient moments as the bursting of a bulb or the impact of a milk drop in a bowl This sound activated flash for 'stop action' photography will give a new dimension to the art of taking photographs

—Vivek Mehra

24 Fibre Optic Transmission Technology
—S.K. Puranik
35 Clean Rooms: Precision tool of sophisticated electronics technology
—K. Barua
43 Photolithographic Techniques for LSI and VLSI: Part II
—J.D. Jain and A. Srivastava
56 Learning the Morse Code with Sinclair Computer
—Ashok Baijal, VU2AEY
61 An Introduction to Compilers: Part II
—Suresh K. Basandra
70 Comparative Study of Computer Languages: Part XIV
—R. Ramaswamy
77 Sound Activated Flash for 'Stop Action' Photography
—Vivek Mehra
85 10-Band Graphic Equaliser
—C. Sanjay

FEATURES

13 Letters
17 What's New
51 Computer Corner
59 Electroons
77, 85 Construction
93 Circuit Ideas
99 Product Profiles
103 Book Reviews
105 Company Profiles
106 Facts & Figures
111 Electronics Mart

Throughput in PCB assembly machines lowers assembly cost

PCB assembly machines of Hollis Automation Inc., U.S.A., give high throughput, are rugged for production floor handling and reliable to provide you trouble-free operation with consistent results year after year.

ASTRA is an automatic wavesoldering machine for continuous high volume soldering of PCB's. It is available in four solder wave widths : 305 mm, 406 mm, 457 mm, 610 mm. "Z" solder wave equipped with oil-intermix in ASTRA enables the user to select oil-intermix or dry soldering as desired. Tn either mode, ASTRA provides superb results on routine or high-density PCB's including multilayers and unusual geometries. It solders surface mounted devices with equally superior results with optional dual solder wave.

GBS Mark III is a unique high productivity wavesoldering and debridging machine in PCB industry. Its precisely engineered microprocessor-controlled airknife clears solder bridges, icicles and unwetted solder joints on difficult-to-solder PCB's. Its useable wave-width is 610 mm. The machine solders 1230 linear meters of PCB's automatically per 8-hour shift when operated at 3 meter/minute speed.

SCS 150 is a high production fully automatic system for long lead locking, cutting and wavesoldering of PCB's with width up to 406 mm. Unclinched straight-through lead wires in high-density PCB's offer advantages of labour and processing saving. The patented Hollis Stabilizer method of locking unclinched lead wires into PCB's for accurate in-line mass cutting before wavesoldering, lowers assembly and soldering costs.

Holli Clean 16 is an automatic aqueous cleaning and drying machine to de-flux PCB's (up to 406 mm width and 51 mm high) in a continuous process. Though highly compact (occupying mere 2.8 square meter of floor space), Holli Clean 16 combines washing, rinsing and drying stages normally found in large machines.

The free standing Holii Cutter 400 works as a unit of total conveyorised system or off-line alone. It trims all lead wires precisely on even most densely populated PCB's (with width up to 406 mm) in a single pass. Holli Cutter 400 meets all OSHA safety requirements.

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References

Satisfied Indian users of such Hollis machines are : AB Controls, Eastern Peripherals, HAL Hyderabad, HAL Lucknow, IDM, Jenson & Nicholson.

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KAVERI

Power Transformer Program

Thank you very much for the article 'Program for Design of Power Transformer' in the March '86 issue of your magazine. I have 'run' the program on BBC Micro and have found that Dimension Statement, i.e. statement no. 25, is incomplete. It has provided DIM for three variables only whereas there are nine variables, dimensions for which are to be provided. Except this the program runs and it is quite a useful program. However, I would like to modify statement no. 10 and 500 to 570 for a better printout of the results.

SUDHIR KUMAR SAXENA
Patiala

□ Dimension statement has not been given for subscripted variables such as T, S, S$, I, Q and V.

Program is correct up to statement no. 105. But while executing statement no. 110, if the statement is true, instead of going to statement no. 130 it should execute statement no. 135. If statement no. 110 is false then the computer should execute statement no. 115, 120 and so on.

The modified list is given below for the correct logic from statement no. 110 to 130.

```
110 IF A$ = 'Y  THEN 135
115 INPUT "SEC. VOLTAGE IN VOLTS", V(2)
120 INPUT "SEC. CURRENT IN AMPS.", I(2)
122 PRINT "ASSIGN 0 VALUE FOR BALANCE VOLTAGE
    AND CURRENTS"
123 RGM. P2 IS OUTPUT POWER
125 P2 = V(2) * I(2)
130 GO TO 160
```

The rest of the program is alright.

R.K. GUPTA
Lucknow

The author, Mr Anil Kumar Malik, replies:
First of all I would like to thank Mr Saxena and Mr Gupta for having gone through my article in detail and taken pains to point out difficulties/suggestions in running the program.

In BASIC, each variable reserves ten memory locations, if it is not dimensioned in DIM statement. That is why subscripted variables were not included in DIM statement, as these used only six memory locations. As BASIC has many versions, this statement will have to be modified, depending upon one's computer and the BASIC's version. However, it is better to dimension each variable in DIM statement to save memory, as well as disc storage capacity.

One can always use TAB function to get better printout depending upon one's preference for presenting the results.

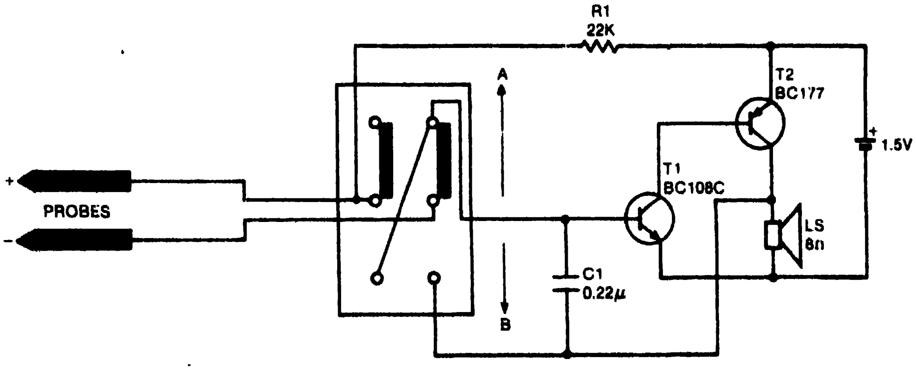
In the program under reference, TAB function was not used, as results were printed under only two columns. This can however easily be achieved by using ";" in PRINT statement as it also behaves like 'TAB' function.

I don't agree with the modifications suggested by Mr Gupta. The three additional statements suggested by him, numbering from 122 to 125, are superfluous and don't increase the efficiency or save CPU time. Instead he has duplicated these three statements without achieving anything.

I want to clarify that each variable is initialised to zero when the program is run, and it remains zero till a value is assigned to it. The statement 130 PRINT "ASSIGN 0 VALUE FOR THE BALANCE VOLTAGES AND CURRENTS" is used to tell the operator to assign '0' value to the balance variables if the transformer has more than one secondary windings but less than five. Suppose, the transformer has three secondary windings, then V(5), V(6) and I(5) and I(6) will be assigned '0' value.

Versatile Tester Simplified Further

With reference to the construction article by Mr D. Venkatasubbiah in the January issue and a modification suggested by Mr M. Ramachandran, Cochin in the April issue, I would like to suggest further modification to eliminate the reversal of polarity of the probes in 'A' and 'B' positions.



POSITION A:CONTINUITY TESTER
POSITION B CAPACITANCE TESTER

With the DPDT switch connected as shown in the above diagram, there would be no change in polarity of the test probes in either position.

B. MEHER MOHAMMED
Visakhapatnam

□ Congratulations for publishing such an excellent article by Mr D. Venkatasubbiah, 'Versatile Tester with Audio Indication' in the month of January. The article proved very useful to me.

ANAND KUMAR GUPTA
Hazaribagh

The author, Mr D. Venkatasubbiah, replies:
It is heartening to get a constructive and useful suggestion from Mr B. Meher Mohammed, an employee of State Bank of India, Visakhapatnam. It shows the abundant popularity of EFY, in addition to exhibiting the deep dedication of Mr Meher Mohammed in electronics-hobby.

Regarding the modification, he is quite correct and such suggestion was already received from other readers. Still, I would like to thank this 'special' reader who thinks of electronics also in his banking service.

Crossover Networks

Many thanks for publishing lucid and informative article on Crossover Networks (EFY March, 1986). However, I would like to point out the following:

1. In the formulae given for calculating the values of C and L there seems to be some error in specifying the units. On substituting the values for 4-ohm speaker system with crossover point at 2500 Hz, the values of C and L come out to be 0.0000159 and 0.0002545 respectively. I think these are values in farad and henry and not microfarad and millihenry as written in the article.

2. In the graph showing impedance curve (Fig. 7 of the article), I presume the Y-axis represents impedance Z and not dB.

3. I beg to differ from learned Mr Osan's contention that electrolytic type capacitors are available only as 'polarised' units. In fact I have personally used 'Crescent' make non-polar electrolytic capacitors, a wide range of which is available with Associated Traders, 43 Old Lajpatrai Market, Chandni Chowk, Delhi. When we put two capacitors in series (to make the combination behave like a non-polar unit) I think it will add up ESR (equivalent series resistance) of the two capacitors and would result in excessive power loss as compared to single-piece non-polar capacitor.

Kindly enlighten me on the above points through good columns of your informative, interesting, elegant and perhaps one of the most authentic magazines on electronics available in India.

RAKESH KUMAR
New Delhi

The author, Mr Jasvinder Osan, replies:
The formulae given in equations (1) and (2) give the capacitance and inductance in farads and henry respectively. Also, the equation (6) in part II (April issue) of the article gives inductance in henry.

The Y-axis of the curve given in Fig. 7 represents variation in voltage in terms of decibels. The curve was traced from the original, which has plotted on a B&K level recorder to show the variation in voltage across the terminals of a speaker, as the input signal from a constant current source is swept. At resonance, the impedance is maximum, and hence the voltage drop across the speaker is also the maximum, which is evident from the plot The Y-axis is, therefore, proportional to the impedance of the speaker

Should non-polar electrolytic capacitors be available readily, then by all means they may be used in crossover networks However, as regards the ESR of the non-polar electrolytic, to my knowledge, the construction of a single piece non-polar electrolytic consists internally of two polarised electrolytics, back-to-back in a single can. Therefore, unless the manufacturer is specifically making these capacitors with a low power factor for use in loudspeaker crossover networks, one would not expect there to be a difference in their ESR as compared to two electrolytic capacitors placed back-to-back otherwise.

Speed Control for DC Motors

Mr A Sehgal's circuit idea on IC Speed Governor for Small DC Motors (EFY, March '86) is very interesting But the circuit described is a mere voltage regulator and will not be suitable for governing the speed against 'load variations' on the motor shaft

This can be achieved only by a feedback arrangement in the circuit about the load level and correcting the input accordingly. All cassette recorder motors which use electronic speed governors operate on this principle There are standard ICs available for this purpose.

Being the first and the only one in India to make IC governed motors, we have done enough studies in this area of design. Such micro motors, with built-in IC speed governors, are readily available in the Indian market.

N. VENKATARAMANI
Product Manager
Rangam Electronics Ltd
Madras

The author, Mr A. Sehgal, replies:
I gave a simple circuit for speed control of small DC motors. In this also speed will not change, regardless of load, when final setting using preset is done. More theory was not given as this was just a useful circuit idea, not a complete article on speed control.

I am well aware of special ICs available for the purpose, but their cost prohibits their use by common hobbyists.

As a low-cost control, this circuit is very handy for common hobbyists. It is not meant for industrial applications.

Computer Languages

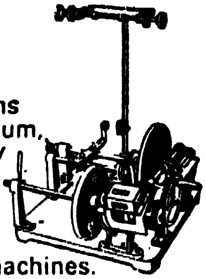
Mr R. Ramaswamy's articles on 'Comparative Study of Computer Languages' is really wonderful! It has helped me a lot in knowing the difference between the various languages and has given me a clear understanding.

However, there was a mistake in the Feb. '86 issue. On page 63, under the subheading 'Library Functions in BASIC against LEN (X$), if X$ is "R. KRISHNAN", then LENX$ will return 10 and not 11, including the period after R Please correct the error.

I'm always eagerly waiting for the next issue to go through this particular topic.

SANTOSH ARVIND
Cochin

The author, Mr R. Ramaswamy, replies:
The value of X$ is "R. KRISHNAN". There is a blank after the period (stop). But in the actual print it is not clearly brought out since R. occurs in the first line and KRISHNAN occurs in the next line. If there is no space between the period and KRISHNAN, the value of LEN(X$) is 10. If the space is taken into account then LEN(X$) is 11.



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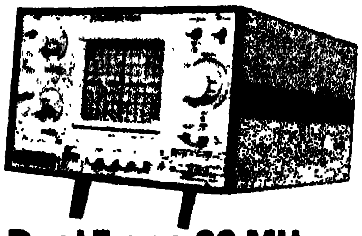

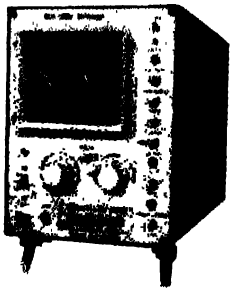

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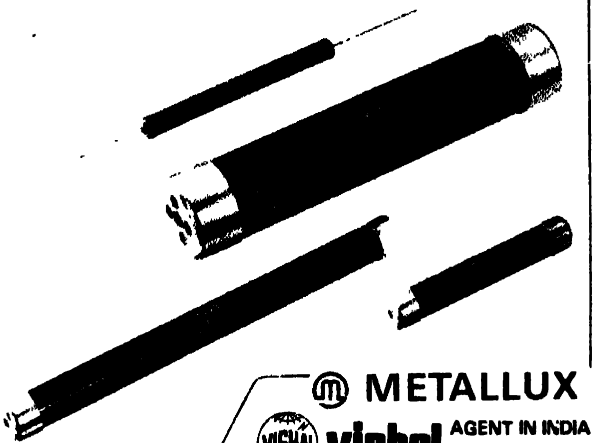

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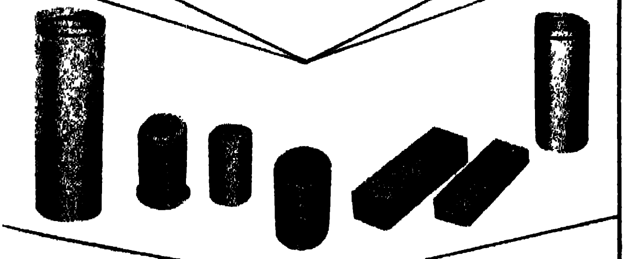

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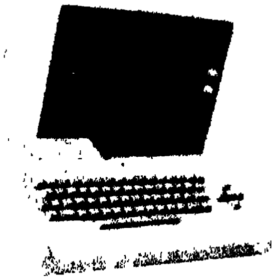

- 25 rows x 80 characters
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- RS-232C compatible interface with selectable transmission format, standard bauds from 75 to 9600.
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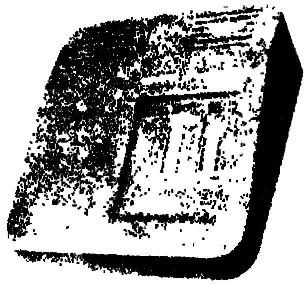

OTHER PRODUCTS

8 BIT SYSTEMS: Microprocessor Trainers ESA 85, MPS 85 based on 8085, ESA 65 based on 6502 and ESA 80 based on Z-80.

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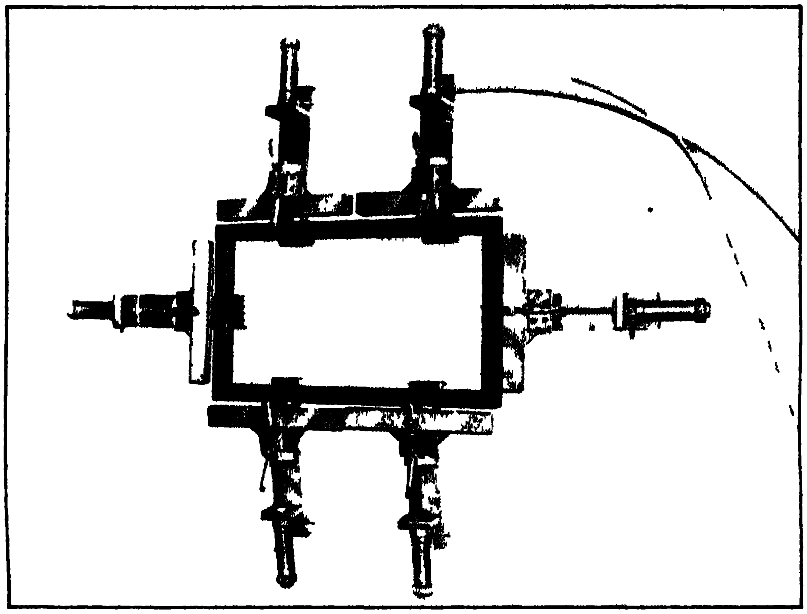

An essential prerequisite for high quality printing and durability of the stencil is the proper stretching of the gauze. The stretching clamps have been designed keeping in mind various factors that govern the preparation of screens for the printing of etch resist, solder mask, lettering and legend printing, and, various other applications in the screen printing industry

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- Cast aluminium upper and lower jaws engineered to precision
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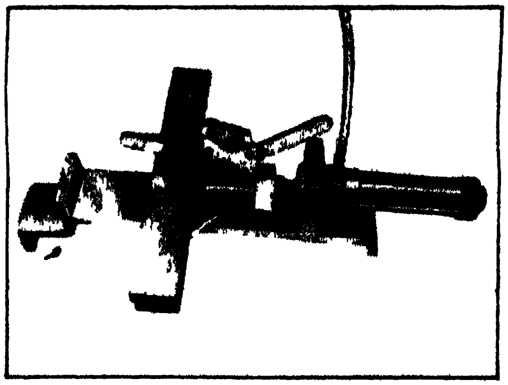
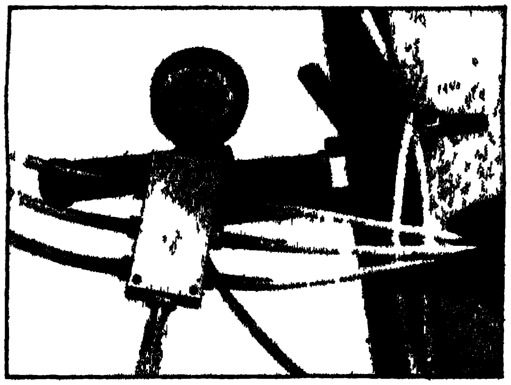


Individual jaw complete with quick action clamp and pressure cylinder A single system can comprise of as many clamps as desired.

←

→

Pressure guage with distributor and pressure lines.



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What's New

IN INDIA....

IITF on electronics industry

The India International Trade Fair organised by the Trade Fair Authority of India annually in November at New Delhi will have the electronics industry as a special theme this year.

For the first time several advanced countries including the United States are making their debut officially. This is expected to attract a large number of buyers and representatives from electronics associations. Trade talks are also envisaged with several countries on increasing two-way trade in electronics during the fair.

As many as six seminars on key areas in electronics have been scheduled. Top representatives of the government as well as Indian and foreign companies are expected to participate

Electrical cables, wires broadbanded

In order to ensure optimum utilisation of manufacturing facilities and to encourage a larger volume of production, the government has decided to extend the broadbanding scheme to the electrical cables and wires industry.

According to a Ministry of Industry notification, since design and production facilities are common for several aggregates of different types of electrical cables and wires, it was felt that a certain degree of flexibility should be allowed to enable the manufacturers to respond to the market demand.

Manufacturers will now be provided flexibility for licensing to produce electrical cables, wires, conductors, strips of all types, excluding telecommunication cables, wired conductors and all types of strips connected with telecom.

Modernisation of monitoring facilities

The monitoring organisation of the Ministry of Communications has procured ninteen VHF/UHF monitoring terminals with microprocessor control for modernising monitoring facilities in these frequency bands at various monitoring stations.

The monitoring organisation has a network of 21 monitoring stations located at Ahmedabad, Ajmer, Bangalore, Bhopal, Bombay, Calcutta, Darjeeling, Dibrugarh, Goa, Gorakhpur, Hyderabad, Jalandhar, Madras, Mangalore, Nagpur, New Delhi, Ranchi, Shillong, Srinagar, Trivandrum and Visakhapatnam to monitor wireless transmissions of all the government and non-government wireless stations, to ensure that they function within the prescribed technical and operational parameters. These monitoring stations also investigate complaints of harmful interference as well as collect data on occupancy/vacancy of radio frequency spectrum.

In view of the extensive exploitation of national and international satellite communication services, an international satellite monitoring earth station is proposed to be established at Jalna in Maharashtra state to monitor emissions from satellites in the geo-stationary satellite orbit, primarily to protect space and terrestrial radio communication services and to implement international radio regulations For this purpose, radio noise free band has been acquired after extensive surveys. Suitable action for civil works and system procurement is being taken by the organisation.

Most import approvals for electronics industry

As a result of the approvals granted by the government, the imports of capital goods are estimated to have gone up considerably during 1985-86. The main beneficiary of these approvals has been the electronics industry.

Detailed figures for April-February 1985-86 show that approvals for the electronics industry went up by a staggering 741 per cent—from Rs 51.8 million in April-February 1984-85 to Rs 435.7 million during the same period in 1985-86.

The total approvals accorded by the Capital Goods (Main) Committee in 1985-86 were to the tune of Rs 8710.2 million as compared to Rs 7440 million in the previous year, indicating an increase of 17 per cent. Besides electronics, the industries for which higher approvals were granted include metals, cement, ceramics and refractories, manmade fibres, textiles, electricals and iron and steel.

TDA export plan for electronic components

The Trade Development Authority (TDA) has drawn up a two-year market development plan for export of electronic components with the assistance of the United Nations Development Programme (UNDP). This was stated by Mr Prem Kumar, Commerce secretary and chairman, TDA, while addressing its 16th annual general meeting recently.

Since the United States is the largest market for electronic components in the world, the plan aims at increasing India's share of the US market. Activities under the project will include development of buyer contacts, participation in specialised electronic trade fairs and sponsoring of sales missions.

The TDA is also preparing a blueprint for the setting up of a National Trade Information Centre with the help of professional consultants, if necessary. This is being done to upgrade the quality of trade information and speed up the mechanism of dissemination, keeping in view that commercial intelligence is a basic prerequisite for a successful export drive.

Satellite earth stations

The Department of Telecommunications has planned to establish about 80 additional earth stations in the country during the Seventh five-year Plan period. This includes fixed and transportable earth stations.

Eighteen earth stations are planned to be commissioned during 1987 in remote, backward and hilly areas. These stations will be set up at Doda, Rajouri, Poonch and Kargil in J&K; Phool Bani in Orissa; Keylong and Kalpa in Himachal Pradesh; Zero, Deporexo, Seppa and Anini in Arunachal Pradesh; Jaisalmer in Rajasthan; Srinagar (Garwal), Joshimath and Uttarkashi in Uttar Pradesh; and Cambell Bay, Diglipore and Mayabunder in Andaman & Nicobar Islands.

Ten transportable earth stations are planned to be commissioned in 1986-87. Twenty-six earth stations are planned to be commissioned progressively during 1987-88 in the north-eastern region.

Proposals in respect of other earth stations are under active consideration for commissioning in the remaining years of the Seventh Plan.

BEL increases B&W tube prices

The public sector organisation Bharat Electronics Limited (BEL) has increased the prices of its black-and-white picture tubes BEL is one of the only two public sector companies manufacturing these picture tubes and controls about 40 per cent of the total production

With this price rise, the 51cm tube will now cost Rs 55 more, while the 35.5cm tube will be costlier by Rs 30. This increase in price works out to 15 per cent As the picture tube is a key component—and the costliest—the prices of B&W TV sets are expected to go up immediately.

BEL has justified the price increase on the ground that the customs duty on glass shell has gone up. On the other hand, the Indian TV Manufacturers Association (ITMA) has reacted sharply to the price rise and feels that this is contrary to the government's assurances on bringing down prices of electronic components.

VLPTs for further TV expansion

In order to cover more parts of the country through the television network, the government will soon begin the installation of very low power transmitters (VLPTs) in various remote areas. Unlike the 100W low power transmitters (LPTs) installed in the country during the initial phase of TV expansion programme, these VLPTs have a power output of 10W only.

The transmitters, with a range of about 20 kms, are ideal for relay in hilly areas, sparsely populated islands or remote locations. The VLPTs will derive power for transmission from solar panels so as to operate in areas where there is no assured supply of electricity

An automatic device will switch on the transmitter when signals are received and switch it off when the signals stop. This will enable the VLPTs to operate unattended in distant locations. Besides, the VLPTs will have a backup transmitter with an automatic switching panel in case of failure.

Doordarshan has placed orders for 40 VLPTs for the Seventh Plan period with the state-owned Gujarat Communications and Electronics Limited.

AIEI suggestions to boost electro-medical industry

The Association of Indian Engineering Industry (AIEI) has urged the government to provide certain duty concessions to encourage the indigenous medical electronic equipment industry.

In a notification in March this year, the government had permitted the import of 111 items of medical equipment in finished form at a concessional customs duty rate of 40 per cent ad valorem, whereas the duty on imported components of such equipment for manufacture in India is as much as 130 per cent. This would naturally hit the indigenous manufacturers of such equipment.

AIEI has suggested that the customs duty for components going into the manufacture of medical electronic equipment should not exceed the rate at which the medical equipment can be imported. The association also wants total excise duty exemption on medical electronic equipment which presently is 15 per cent This is in keeping with similar concessions extended to the computer industry

The association has also urged the government that items of medical equipment available indigenously in the right quantity and quality should not be allowed to be imported and, if allowed, should be at a rate of duty so that landed costs are higher than the price of the indigenous equipment

AIEI, however, has welcomed the government's announcement to reduce customs duties on components required to manufacture vital life-saving and patient care medical equipment.

Demand for TV sets slackens

The projections of the Department of Electronics (DoE) for 1986 show that the TV market, which has grown by leaps and bounds at a rate of over 20 per cent a year since the Asiad boom, has remained completely stagnant for the first six months of the year It is also projected that the market situation is unlikely to improve until well into 1987.

Several reasons have been attributed to this recession in the sales of TV sets. The foremost is the hike in excise duty for CTV sets as well as smaller sets in the last budget. The appreciation in the value of both yen and DM has affected the prices of components imported from Japan and West Germany, further raising the prices of the end product. The slackening in the TV expansion network is seen as another contributing factor for the low demand as hardly any new area has opened up for TV sales.

Different rates of sales tax on TV sets in the states—one favouring the local brands with lower tax and another for brands from other states—are also creating a problem for TV manufacturers selling on a nation-wide basis.

Market experts see the current trend as a first step towards the elimination of all but a handful of big companies in the market in the long run. This is a worldwide phenomenon where only companies with large economies of scale would survive in the field. Nevertheless, the TV industry in India is definitely heading for some changes in the not-so-distant future.

New Elcina committee

The new executive committee of the Electronic Component Industries Association (Elcina) was elected recently. Mr Om Wadhwa, chairman and managing director of J.V. Electronics Limited, New Delhi was elected as the president. Mr Wadhwa was president of Elcina during 1980-82 also, and has been on the associations' committee for a number of years

The other members of the new committee are Dr N.D. Desai and Mr A.J. Devapragasam (both vice-president), Mr Sanjiv Narayan (honorary secretary) and Mr O.N. Sharma (honorary treasurer)

Office efficiency exhibition

An exhibition on 'Office Efficiency' is being organised in New Delhi from September 19 to 21.

The products to be displayed will include computers and computer peripherals, electronic typewriters, communication aids, desk-top printing machines and all other types of office equipment designed to promote productivity in the office. The exhibition is likely to attract most senior level executives from the industry as well as the government departments.

Further details regarding participation may be obtained from Dynamic Expositions, G-13 Sahyog, 58 Nehru Place, New Delhi 110019, before August 18.

Workshop on low voltage switchgear

The Central Power Research Institute (CPRI) is conducting a workshop on 'low voltage switchgear' on September 12 at Bangalore.

CPRI is one of the advanced centres for testing and research in switchgears. The institute has two fully equipped testing laboratories for the purpose. CPRI has organised this one-day workshop in order to share its experiences on the low voltage switchgears with engineers and technical managers from industries, testing houses, academic institutions and other research institutions.

Those interested in attending the workshop may contact Mr C.S. Sharma, Convener, Workshop on Low Voltage Switchgear, Short-Circuit Laboratory, CPRI, PB No. 1242, Bangalore 560012, before August 31.

...AND ABROAD

CCIR endorsement for digital television

The XVIth Plenary Assembly of the International Radio Consultative Committee (CCIR) which was held at Dubrovnik, Yugoslavia recently gave its final unanimous approval to new recommendations on digital video interfaces and on recording digital television on magnetic tape.

The new CCIR recommendations open the door to the realisation of fully digital television production studios, since they make it possible to interconnect freely digital studio equipment by means of a single digital video interface signal and by setting a single digital tape recording format to record, edit and exchange digital television programmes.

Experts all over the world believe that the new digital television standards will open a new era of unequalled recording, editing and postprocessing flexibility in the production of television programmes, and in the exchange of superior quality recorded programmes among broadcasters.

Digital coding of component signals, rather than conventional PAL, SECAM or NTSC composite signals, offers great benefits to broadcasters and programme producers since it allows almost unimpaired postprocessing capability. Special effects, electronic tricks and sophisticated picture manipulations can be performed on recorded signals with the same level of quality that would be achieved if they were performed 'live' on the studio output signal.

Single-wafer dry-etching system

An advanced, manually loaded, single-wafer dry-etching system for pilot production or development-laboratory use has been introduced by a British company. The Plasmafab 360 will process 100mm, 125mm or 150mm wafers with the added flexibility of plasma, reactive-ion or triode etching modes.

Housed as a compact economic package, it has an aluminium process chamber derived from the manufacturer's proven advanced production etching systems. Two solidstate RF power supplies are available: the standard 300W, 13.56MHz unit and a 300W, 187.5kHz unit. The system can be supplied with manual, semiautomatic or fully automatic control.

Contact: Miss K. Maxwell, Electrotech, Thornbury Laboratories, Littleton-upon-Severn, Bristol, England BS12 1NP.

Sine wave from the mains

The electricity supply companies demand clean loads so that the uniform AC voltage across the entire network is not distorted. The power companies above all find high-power switched mode power supplies (SMPS) to be a thorn in their sides, since they feature operating frequencies right into the kilohertz range and can place a considerable load on the mains network.

Siemens, West Germany, has introduced an SMPS control IC (TDA 4814) containing all the control and regulatory functions required to develop an SMPS with sinusoidal mains current consumption. The chip which is housed in a DIP 14 package is designed to work with 'SIPMOS' switching transistors.

Siemens' SMPS control IC, TDA 4814.

An example of an application for the TDA 4814 is in electronic starters for fluorescent tubes. If there is a concentration of a number of tubes at a specific point in the mains network, the problem of clean mains current consumption becomes particularly serious. An application devised by Siemens for the TDA 4814 uses the device's operational amplifier (80dB no-load amplification, 2MHz transit frequency) to compare the divided output voltage with a temperature-stable reference voltage (of typically 2V). The output voltage so generated is multiplied by a sinusoidal voltage: a variable-amplitude sine wave appears at the output of the on-chip multiplier.

The comparator output passes the compared signal by way of a logic circuit to the driver, which switches a 'SIPMOS' transistor. So as not to endanger the sinusoidal form of the mains current, no breaks in the current must occur in the choke in the starter unit. The TDA 4814 therefore senses via the $I_{detector}$ input whether the choke current has dropped to zero after the 'SIPMOS' transistor has switched off. This ensures that the transistor is not switched on too soon, that no breaks in the current occur and that the mains current remains sinusoidal. The upper switching-voltage threshold of the input is 1.5V (for a rising voltage) and the lower threshold is 1V (for a falling voltage).

Automated laser robot soldering in prospect

An automated soldering work station that combines robotic and laser technologies to automatically assemble circuits using surface mounting technology, is under development at Hull university in northern England. A university team is working on the system to form part of an electronic assembly line which should increase reliability and precision over current techniques.

The new system will incorporate a compact infra-red laser which has been developed over the past few years from research on radio frequency gas discharges at Hull university. The use of the laser will give speed, flexibility and precision. A vision-assisted microprocessor-controlled positioning and orientation system will be developed to provide accuracy and repeatability.

The application of lasers to soldering is a recent but rapidly expanding development. The advantages lie in the ability of the laser to perform its function on exactly the area to be processed, and, with the radiation and exposure being accurately controlled, only the precise amount of heat necessary for the bond need be used. The speed of soldering which is possible also minimises the risk of weakening of soldered joints—laser soldered joints are reported to be less brittle and more resistant to fatigue failures than those made by conventional methods. A laser soldering unit for this sort of work must be guided with some precision so vision sensing will be incorporated to allow components to be accurately monitored and positioned. Vision will also be used to inspect work in progress.

The aim of the university team is to develop a semi-automatic prototype system which will be subjected to trials at the facilities of one of the collaborating companies, thus providing operational experience in an industrial environment.

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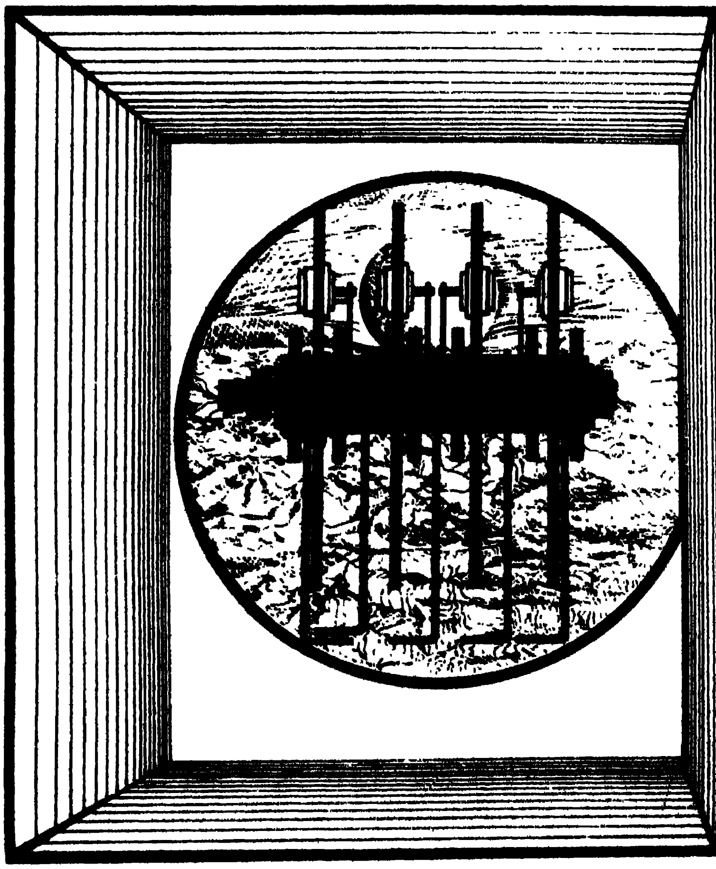

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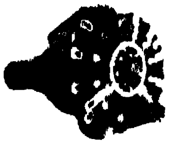

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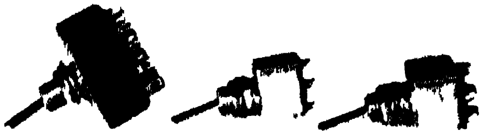

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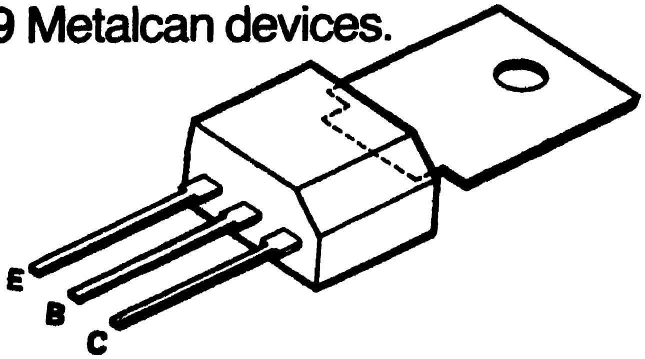

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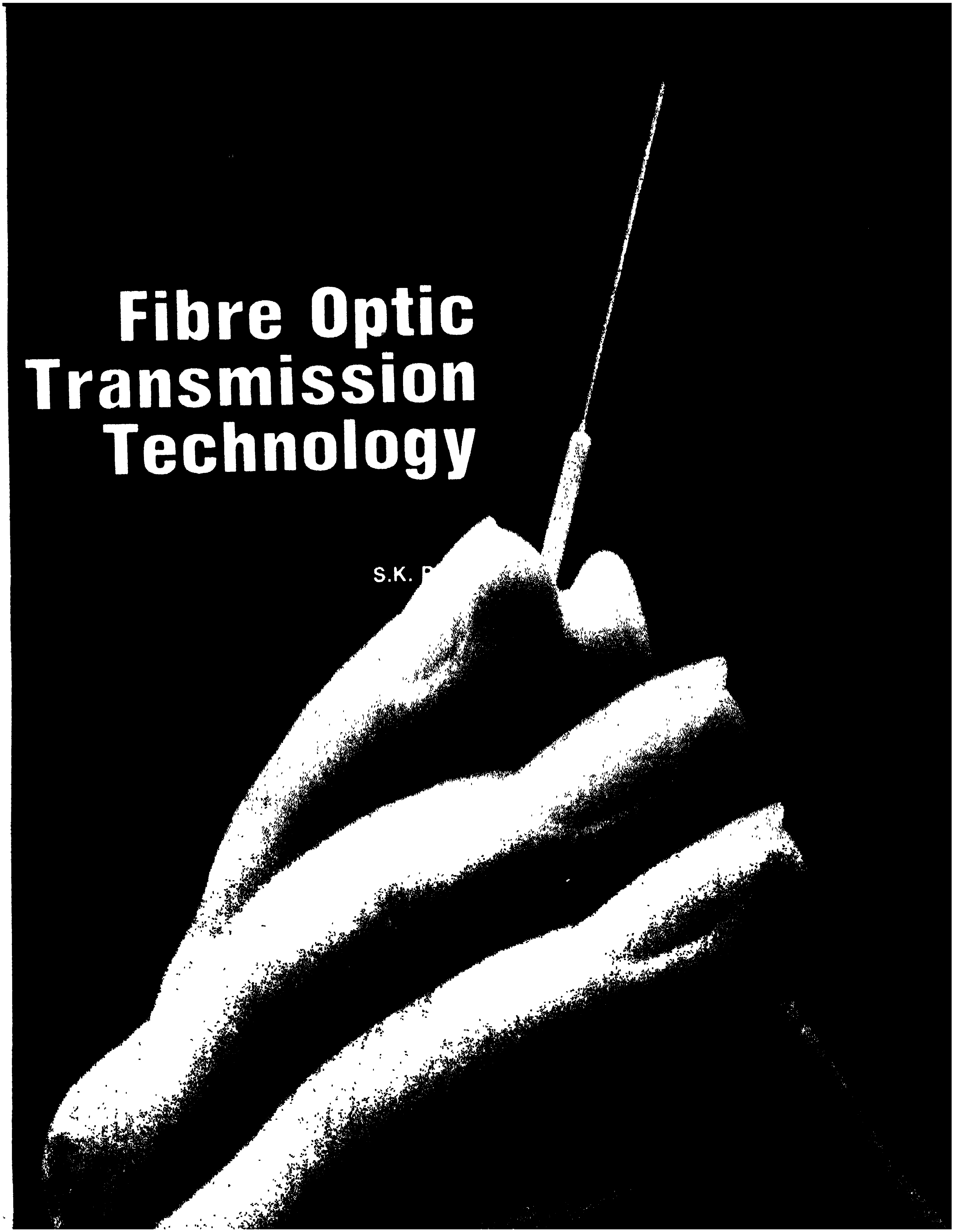
Fibre Optic Transmission Technology

S.K. P



Fibre Optic Transmission Technology

Fibre optic transmission technology has made great progress as one of the leading forces towards a more advanced information society. The low transmission loss, noise immunity and wide bandwidth of optical fibres now make it possible to realise cost effective and highly reliable systems in a broad spectrum of applications transmission of audio, video, high speed digital and analogue signals in local exchanges and long-haul communication systems, instrumentation, local area networks, distributed computer control systems and also in special purpose systems.

Fibre optic transmission technology owes its origin to two epoch-making scientific breakthroughs made in 1970: one, the success of Corning Glass Works in the large-scale reduction of transmission loss in optical fibre and two, Bell Laboratories' achievement of continuous operation of a semiconductor laser at room temperature. Since then, this technology has developed very rapidly and today finds wide scale industrial and commercial applications. It has exceeded the expectations of even the most optimistic forecasts in market projections

Advantages

Fibre optic cables compare favourably with HF symmetrical and coaxial cables. Optical fibre systems offer a number of advantages.

Wider bandwidth. Existing optical fibre systems transmit hundreds of MB/sec over thousands of kilometres. AT&T's latest system can handle 6000 simultaneous telephone calls on each pair of fibres (a pair is required: one to transmit and another to receive the signal). This capacity will increase four-fold by 1988. An experimental system that should be commercially available within a few years transmits 2 billion bits/sec over 100 repeaterless kilometres. At this rate, the entire text of the 30 volumes of 'Encyclopedia Britanica' could be transmitted in less than a second.

Attenuation. Repeater span of over 100 kms has been achieved with 2 dB/km attenuation at 1.5*um* wavelength, resulting in increased system reliability as well as lower initial and maintenance cost.

Mr S.K. Puranik is incharge of the electrical/electronic laboratory set up for commissioning of the 4M1 expansion work at the Bhilai Steel Plant.

Noise immunity. Optical fibres are inherently immune to radiation and electromagnetic and electrostatic interference such as lightning, motors, EHT (extra high tension) power lines, radio frequency and crosstalk, irrespective of data rate.

Size and weight. The greater signal carrying capacity is accompanied by its smaller size and lesser weight. A copper cable carrying 36,000 channels has a diameter of 7.5 cm and weighs 11 kg/m. By contrast, a fibre cable carrying 50,000 channels is only 1.25 cm in diameter and weighs just 1.2 kg/m. This saves in shipping, storage and installation costs.

Compatibility with conventional electronics. Fibre optic systems match perfectly with the present day electronic communication systems utilising digital CMOS/TTL integrated circuit and large scale integrated circuit technology.

Modular design. With their modular design, each component of fibre optic system can be upgraded individually, without the need for an overhaul of the entire network.

Security. It is extremely difficult to tap a glass fibre without detection. This makes it ideal for military and other sensitive applications.

No scarcity of raw material. It is made of silica, available on earth in abundance.

Safety. There is no sparking or short circuit in optical fibres. It can be used in hazardous environment.

Insulating medium. Its dielectric property is advantageously utilised in several applications.

The fibre optic transmission system can be divided into three main functional units: (i) the transmitter or the source; (ii) the receiver or detector; and (iii) the propagating medium.

Transmitter or source

The electrical signal input to the transmitter is converted into light signal output which in turn is launched into the fibre cable through suitable coupling. The transmitter consists of a modulator or coder, a driver circuit and a temperature compensating circuit and a transducer.

Transmitters are available in sizes as small as 1.5 cm × 3.7cm, 24-pin, dual-in-line modules. Integrated circuitry is used for coder, driver and compensation circuits. Input of the module matches the electronic communication circuits delivering the input electrical signal to the transmitter.

The transducer for converting electrical energy into light should be a small, bright, fast, monochromatic source for efficient, long distance, fast data transmission with low dispersion and high reliability. Light emitting diodes (LED) and laser (light amplification through stimulated emission of radiation) diodes (LD) are used for this purpose. Both can operate in either the short-wave or long-wave spectrum. Early developments were confined to the operation of source transducers in the short wavelength region.

LEDs (typically 50μW output/100mA driving current/2.5V operating voltage) and LDs (typically 5mW output/70mA threshold current/0.5ns rise and fall time) of GaAlAs/GaAs double heterogenous structure are used for 0.76-0.89μm and GaAsP/InP/buried-heterojunction type LDs (typically 3mW/30mA threshold current/0.5ns rise and fall time) are used for 1.2-1.6μm wavelengths.

LED is a low-cost, simple, reliable long-life device with linear input/output characteristics. On the other hand, the laser diode is not a very stable device. Due to the strong dependence of its threshold current on temperature, the laser diode should be operated at some fixed temperature within the operating range. The temperature is controlled by peltier cooling elements.

Fabrication of LED and LD is done with a double heterojunction, liquid phase, epitaxial growth process. Due to wave guiding characteristics of the recombination layer, energy is emitted in a narrow cone in the plane perpendicular to the plane of the junction. LDs and LEDs are provided with factory assembled fibre pigtails so as to avoid the need for field alignment of fibre to the devices.

Receiver or detector

It receives the optical signals from the transmission link and converts them into electrical output signals. The receiver consists of transducer, amplifier, threshold detector, comparator, error detector and decoder or demodulator. Receivers are also available in sizes as small as 1.5cm × 3.7cm, DIL module. Integrated circuit technology is used for the various receiver circuits.

Major receiver transducer requirements are high efficiency, high speed response, low noise and low operating voltage. Photodiodes, used as receiver transducers, are of two types PIN (P, N and I intrinsic) and APD (avalanche photodiode). In response to the light signal received from the transmission link, reverse biased detector delivers electric current to the load resistor. PIN diodes require about 5 to 20 volts and APDs as much as several hundred volts.

APDs have internal amplification due to the avalanching (multiplication by collision) of free charges. Gains up to several hundred are obtainable, making an APD receiver more sensitive than a PIN diode receiver. High cost and the need for large power supplies are the disadvantages of an APD. Silicon photodiodes are suitable for short wavelength region and have a peak responsivity of about 0.5 A/W at 0.85 μm. Germanium (Ge) and indium gallium arsenide (InGaAs) photodiodes have responsivities close to 0.7 and 1.1 A/W respectively in the 1.3 to 1.55μm range.

Block diagram for dual-in-line, 24-pin transmitter and receiver modules are shown in Figs 1 and 2 respectively. Specifications of the transmitter module in Fig. 1 are as follows:

1. 0-2MB/sec data rate
2. 27dBm light output (80μm cone)
3. 800-900nm wavelength
4. GaAlAs LED light source
5. +5 ±0.25V voltage supply
6. TTL compatible
7. -20° to +70°C operating temperature

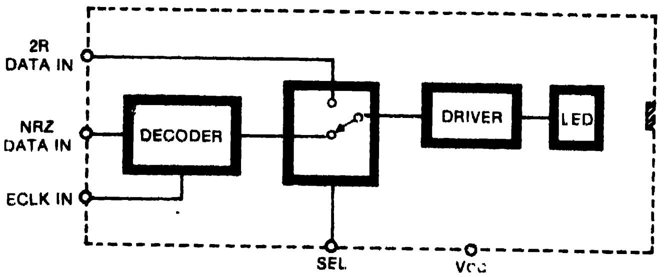


Fig. 1: Block diagram of transmission module.

8. 7.5mm × 10mm × 37mm size.

The receiver module in Fig. 2 has the following specifications:

1. 0-2MB/sec data rate
2. -38dBm minimum receiving power
3. 20dB AGC range
4. Si PIN detector
5. 1-4MHz clock frequency
6. TTL code level
7. 5 ±0.25V voltage supply
8. TTL compatible
9. -20°C to +70°C operating temperature
10. 7.5mm × 15mm × 37mm size

These modules are TTL-compatible and accommodate arbitrary data formats. They provide data transmission over 2 km at a 0-2MB/sec NRZ (non-return to zero) data rate. These modules use 80μm graded, index profiled optical fibre with an attenuation of 15 dB/km. Operating on a single 5V supply, they provide timing signal transmission and automatic link monitoring signal detection to realise regenerative multi-repeating transmission.

Propagating medium

Plastic and glass fibres are used as the propagating medium of light signals from transmitter to receiver. The principle of transmission of energy along an optical fibre is similar to the concept of total internal reflection which occurs when light in a glass core strikes the boundary of the glass sheath of lower refractive index at greater than the critical angle. It is directly dependent upon the ratio of the two refractive indices. Plastic fibre cables are used in optical transmission because of their low cost, high source-fibre coupling efficiency and ease of handling. Their attenuation is high and restricts their application to short links of around 30m.

Optical glass fibre cables consist of a glass fibre clad with a sheath of different glass. The core has a higher refractive index than the sheath. The fibre glass is made of pure silicon. It should have a very low optical scattering and absorption for low losses. The transmitted energy must be optimum with regard to amplitude and phase for maximum transmission capacity.

Despite its high tensile strength, glass fibre needs protection against excessive mechanical loading forces which might occur when pulling a fibre cable through a duct or when hanging it between two poles. To minimise the effect of lateral crushing force, one or two soft plastic buffering layers normally cover the sheathed fibre. Applied shortly after production of the fibre, this buffer provides cushioning and resistance to scratches.

The buffer fibre may be placed loosely within a surrounding plastic tube. In the loose tube the fibre is isolated from external crushing forces and is relatively insensitive to cable bending. The tube may be surrounded by tensile strength member (kelvar) brading. It is further covered by a plástic sheath such as polyurethane to protect against abrasion and to ease handling (Fig. 3). Moisture protection can be provided by filling the tube with a gel. Steel or fibre glass rod is placed inside the cable for increased strength. Armouring can also be included for further protection.

The three type of fibres are: (i) step index fibres (SI); (ii) graded index fibres (GRIN); and (iii) single mode fibres.

Step index fibre

Step index fibre has an inner glass core whose refractive

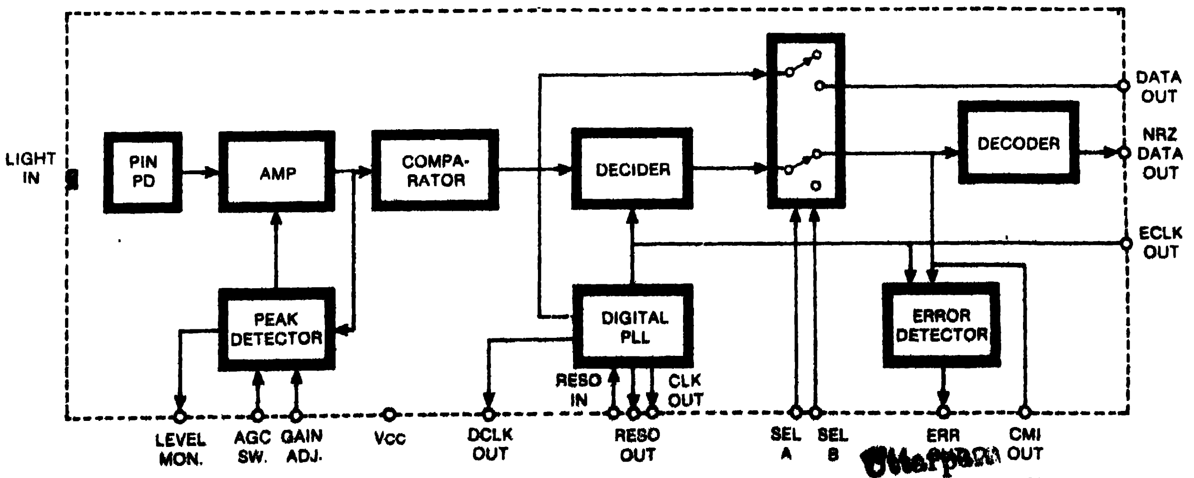


Fig. 2: Block diagram of receiver module.

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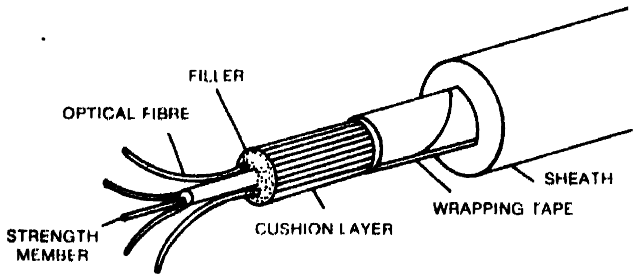

Fig. 3: Long wavelength, four-core layer type optical fibre cable structure.

index is slightly greater than that of the surrounding glass cladding. Variations include a glass core with plastic cladding and a plastic core with plastic cladding. It is called step index fibre because of the rapid change in refractive index at the core-cladding boundary, giving rise to a step-like profile. Refractive index remains constant from the core centre to the core boundary.

The core traps rays of light by a phenomenon called total internal reflection. Light rays which strike the core-cladding interfere at an angle greater than the so-called critical angle and undergo 100 per cent reflection. The equation $\sin \phi = n2/n1$ determines the critical angle, where n1 and n2 are the refractive indices of the core and cladding respectively.

The wave guiding process consists of light rays zigzagging down the fibre, continually reflecting at the core cladding interface. While medium bending does not seriously disturb the transmission process, excessive bending will cause some rays to fall below the critical angle, resulting in leakage of the light out of the core into the surrounding medium.

Information carrying capacity of a transmission line is proportional to its bandwidth. For fibres, the bandwidth is conventionally included in its characteristic bandwidth-length product (B × L). Step index fibres have a bandwidth-length product value of 25 to 30 MHz/km.

Graded index fibre

Graded index fibre has a refractive index which decreases continually from the core axis to the outer edge. The refractive index variation causes light rays to follow sinusoidal paths along the length of the fibre rather than undergoing abrupt reflections, as in the case of the step index fibre.

The higher order modes travel longer distances faster so that all modes arrive at the receiver nearly at the same time. Graded index fibre has a bandwidth-length product value of 600 MHz/km or more.

The bandwidth capacity arises from signal attenuation. Thus, system design requires the following two separate calculations to determine the suitability of a fibre for prescribed bandwidth and length:

1. A calculation of total attenuation to ensure that sufficient power reaches the receiver to clearly detect the intended message.

[illegible] A calculation to ensure that the bandwidth-length product is not exceeded.

Typical fibre cores (50 to $200 \mu m$ diameter) greatly exceed the operating wavelengths making these fibres multimode waveguides. This means that the light injected into one end of the fibre breaks up into many different patterns for transmission to the other end.

In step index fibre, the different modes correspond to rays travelling at slightly different angles as they zigzag down the fibre. Numerous modes also exist in large GRIN fibres. The differences between the modes of these fibres are difficult to describe in a simple manner. Nevertheless, many different patterns of light are possible in a multimode GRIN fibre.

For both SI and GRIN fibres, different modes travel with different velocities. This causes distortion of the modulated wave shapes. The amount of distortion increases as the wave travels through fibre. It is primarily this effect which limits the bandwidth of multimode fibres.

Single or mono mode fibres

Single mode fibres improve the above situation. Limiting the core diameter to a small size of 0.005 to 0.006 mm in single mode fibre helps propagation in the axial mode only. As the multimode distortion is eliminated, these fibres have much higher bandwidth capacities ranging up to several thousand MHz/km.

Since different wavelengths travel at different velocities, material dispersion for single mode fibres contributes most heavily to signal distortion. Material dispersion manifests itself when white light is decomposed into various colours by a glass prism. The different velocities lead to an unequal amount of bending of ray sources which emit light over a small but significant range of wavelength. The accompanying range of wave velocities occurring in the dispersive fibre results in signal wave shape distortion. Dispersive distortion would disappear if the source emitted perfectly coherent, i.e. single frequency, light. Since dispersions in glass disappear around $1.3 \mu m$, single mode fibres have extremely large bandwidth capacities at this wavelength. It has a bandwidth-length product value of 10 GHz/km.

Single mode fibres are difficult to use because of their thin core. Precision connectors are expensive and splicing must be performed carefully. Single mode fibres operating in a low loss, small dispersion, long wavelength region provide the capability for constructing long, high data rate links.

The system designer must choose between step index, graded index, multimode and monomode fibres, specifying the operating wavelength.

Connectors/coupling

For connecting fibre cables to the attached devices, optical connectors are required. These can be repeatedly connected and disconnected without affecting the system performance. Similarly, connectors are required for connecting cable to cable. Precision machine parts are used for coupling. Available connectors are moderately successful in minimising losses. Typical high quality connectors have losses less than 1 dB.

A fibre does not transmit all the rays of light incident upon its face. It efficiently guides only those rays which strike it within a small angular range. Rays within this range undergo total internal reflection for index fibre. They are preferably redirected periodically towards the core axis for GRIN fibres. Incident rays falling outside the acceptance range are eventually lost by transmission into the fibre cladding and buffer.

The fibre numerical aperture (NA) is given by $NA = \sin \theta$, where θ (called the acceptance angle) is the maximum incident ray angle (measured from the fibre's axis) that will result in efficient transmission. Manufacturers' data sheets always include this important fibre characteristic. Numerical apertures of typical fibres range from 0.1 to 0.5. The corresponding acceptance angles vary from 5.7^0 to 30^0.

Most light sources emit rays over a wide angular range, normally much larger than the fibre's acceptance angle. Due to this the source to fibre coupling efficiency can be quite low. For surface emitting LEDs, the coupling efficiency into a multimode step index fibre is $(NA)^2$. This is applicable when mounting the LED directly against fibre end.

For example, if NA is 0.2, the efficiency is only 0.04 or 4 per cent. This represents a 14dB power loss in transferring light from the source to the fibre. The surface emitter radiates light over a cone whose full apex angle is 120^0, while the fibre in this example only collects light over a 23^0 core angle corresponding to an 11.5^0 acceptance angle.

Edge emitting LEDs concentrate their light a bit more than surface emitters so that the coupling efficiency improves a few dB in relation to the results predicted by the preceding equation. Laser diodes concentrate their radiation even more. Laser diode coupling losses of 3 to 5 dB into a 0.2 NA fibre are possible. In system design, one of the first considerations is the source-to-fibre coupling glass.

Lenses are often used to collimate the light radiated by a source. This improves the source coupling efficiency by decreasing the divergence of the emitted light rays. Coupling light from the fibre into the detector is relatively easy. The fibre simply butts against the detector's surface. Due to the detector's insensibility to ray direction, nearly all the detector's active surface is larger than the fibre's core.

Cabling and splicing

Cable laying is easy. Fibre optic cable can be laid directly in the ground or in ducts, or erected on utility poles. Both permanent and temporary fibre connections need to be made in fibre links. Low loss connections require (i) smooth and parallel fibre end faces, (ii) minimum air gap between the fibres, (iii) angular alignment of the two fibre axes, and (iv) axial alignment of the two fibres. These conditions are met with varying amount of success by a number of connectors and splicing schemes.

Flat ends are obtained by several methods. In one, the fibre is scribed lightly with a sharp, hard (diamond or sapphire) blade and then pulled apart. Tools are commercially available to perform this operation. Rubbing the fibre with a fine sand paper and polishing compound also help. Mechanical alignment performed by connector bodies is not a simple task because of the small diameter of most fibres. For example, a 50μm fibre has a loss of about 0.6 dB if the axial misalignment is only 5μm.

Permanent connections between fibres are most easily produced using fusion splicers. The two fibres fuse together when heated in an electric arc. Losses of 0.1 dB are common.

Developments and future trends

Initial optical fibre development was confined to a multimode technology. 1982 saw its commercial development and initial installations of single mode fibres. Single mode is superior to multimode technology as its more concentrated power allows for longer distances before the optical signal needs to be regenerated.

Today graded index fibres are made in commercial quantity. With an attenuation of less than 4 dB/km to a wavelength of 0.80μm, single polarisation optical fibre will find use in coherent optical communications of the future and optical sensing equipment. This low-loss fibre has excellent polarisation retention properties, even with disturbances such as bending, vibration, thermal changes. It thus transmits the phase information as well as optical energy. Attenuation as low as 2 dB/km at 1.5μm wavelength has been achieved which is close to the theoretical minimum at that frequency.

Development is progressing on a new and original technique for fibre production called the root accumulation method. This technique guarantees excellence in quality and performance features. Infrared fibres such as fluoride glass is being developed. Ultra-low loss of 10^{-3} dB/km at 2-4μm is expected to be achieved practically.

Since the optical fibre exhibits a natural minimum signal attenuation of around 1.3 and 1.5 microns, recent device development has focused on laser diode and LED operation in that area. BH-type (buried-heterojunction type) 1.3μm long wavelength band laser diode has been developed. It is excellent for use in long-haul transmission in view of its low threshold power and single mode oscillation characteristics.

Fibre optic transmission system

The first generation of fibre optic systems (whose installations began around 1976) operated in the short wavelength region because of the availability of suitable light sources and detectors. This region will always be popular because of the relatively low cost of these devices.

Second generation systems utilise the lower loss, long wavelength region. Fibres have greater information carrying capacity in this region.

Third generation systems combine single mode fibres with highly coherent laser diodes in the long wavelength region.

Exceptionally high data rates and extremely long transmission paths have resulted.

Considering the developments in communication systems during the past several years, it is evident that applications of fibre optic communication systems are becoming more and more practical. Optical fibre networks have now been introduced in such industries as electrical power, steel, automobile as well as in long distance optical transmission systems in public telecommunication networks.

Development of fibre optic systems is associated with the development of optoelectronics. Optoelectronics has the potential of developing new communication and information processing systems by means of integrating devices and systems. In coming years, optoelectronics should play a key role in upgrading information systems and its impact on information industry will become more and more apparent.

Several transmission systems have been developed, for diversified applications such as (i) short wavelength transmission modules for the communication, (ii) long wavelength transmission modules for telecommunications, (iii) digital transmission modules, (iv) analogue modules for TV transmissions, and (v) system modules including link transmission modules for use in data loop transmission systems such as office automotion fibre loop link systems which carry voice, data and facsimile signals and highway traffic control systems.

Some of the systems slated for current and future development are:

1. Digital video transmission system that simultaneously transmits one TV channel as well as voice and data signals.
2. Bidirectional wavelength multiplexed transmissions carrying audio, data and request signals as well as video signals.
3. High resolution TV and TV telephones applications.
4. Fibre optic subscriber distribution systems.
5. International submarine optical fibre systems.

Digital and analogue transmission links are designed specifically for the fibre optic transmission systems consisting of a modular or subrack transmitter and receiver in small compact package. These systems offer the designer a choice of sensitivity, bandwidth, and other specifications making them useful in a wide variety of applications such as data transmission, high voltage optically isolated data systems, computer interface, process control and instrumentation. These small-size modules are complete functional units requiring a standard TTL data input and 5V power supply for operation at data rates of 50 MB/sec for distances over 2 km.

Fibre optics find application in a variety of modern transmission systems. Let us briefly discuss some systems developed and used for commercial applications.

Long wavelength transmission system

An optical PCM transmission system used for medium capacity communication is configured in Fig. 4. It is a 32MB/sec optical transmission system with a wavelength of about 1.3μm and repeaterless transmission distance of 35 km. The system uses GaAsP/InP LD for optical source and Ge-APD for optical detector. The matchbox-size LD module contains a peltier device and thermistor, a photodiode, three rod lenses, a beam spliter and an optical connector. Coupling loss is 3 to 7 dB. The module is a smaller device consisting of Ge-APD, a rod lense and a connector. Its coupling loss is less than 3 dB with a quantum efficiency of 70 per cent.

The two-way optical transmission equipment (OTE) is composed of the following packages: a bipolar unipolar converter (B/V), two optical transmitters (E/O), an optical directional-coupler (OPT-HYB), a modulator and demodulator (OW-SV), optical converter (U/B), an error detector (ERR-DET), and a power supply (PS). OTE is connected to a multiplexer (MUX). Bipolar code is used between the interface of the OTE and the MUX. OTE size is 250mm × 520mm × 225mm. Its subrack structure makes installation and maintenance easy.

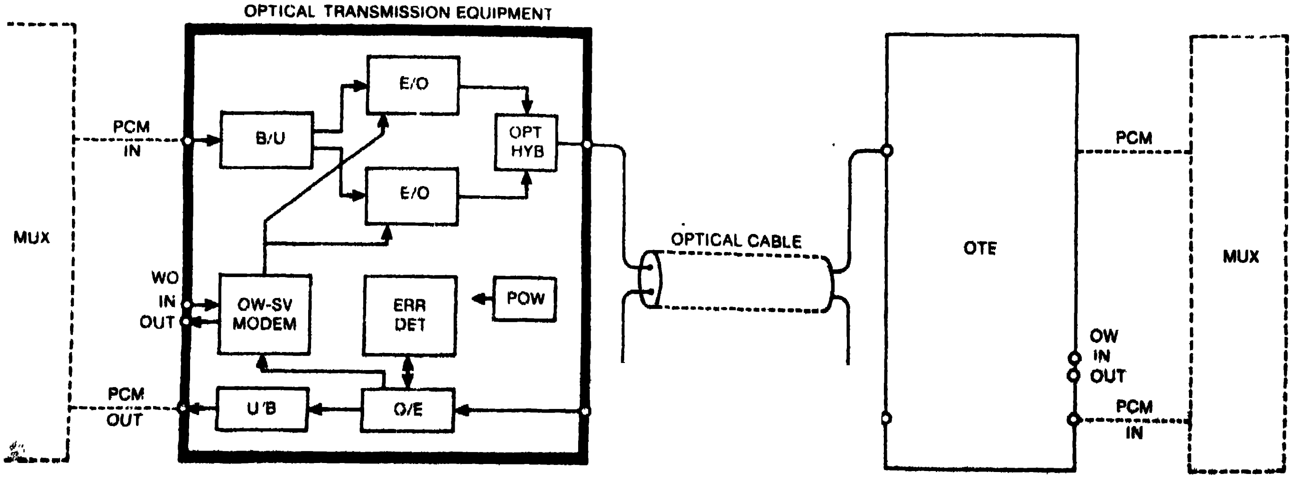

Fig. 4: Configuration of an optical digital transmission system.

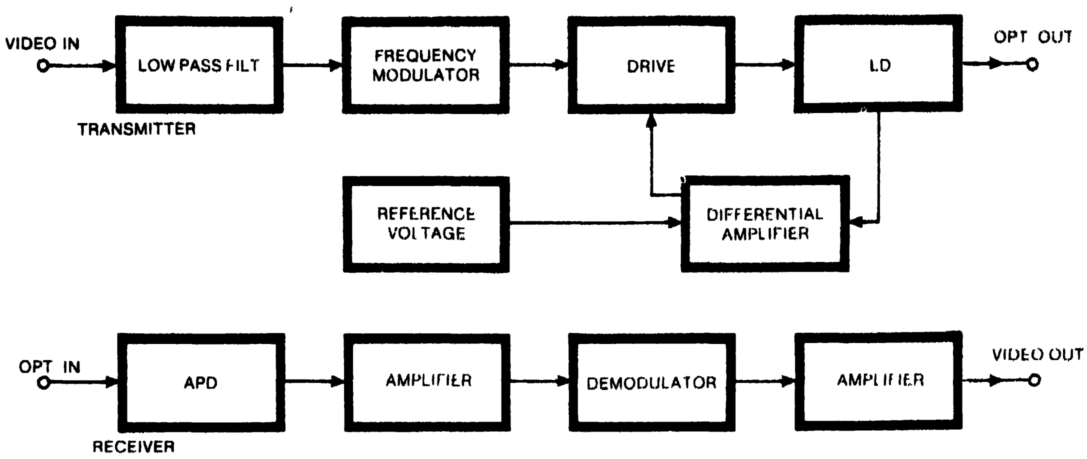

Fig. 5: PFM equipment configuration.

Analogue optical video transmission system

Higher resolution on video pictures and longer distance transmission can be realised by using optical fibre video transmission. It is superior to metallic line video transmission because of its wide bandwidth and low optical loss and less noise. It is being used increasingly in industrial television systems (ITV), video response systems, CATV and other areas.

System configuration shown in Fig. 5 is a pulse frequency modulation system (PFM) with laser diode (1.3μm wavelength) used for about 20 km long distance transmission for video monitoring (used in railway, highways etc). In this system, the carrier frequency is modulated by the video signal and the modulation output is changed to a pulse waveform. The laser diode current is driven by this pulse. At the receiver, transmitted signal is demodulated into a video signal. The SNR obtained by the system is 51 dB after 20 km transmission.

Optical fibre data free-way (DFW) system

With greater automotion and integration, local area networks have become larger and more advanced in process control and office automation areas. With its excellent properties such as low attenuation, broad bandwidth, and totally dielectric transmission medium, fibre optics can effectively realise communication subsystems like wide area, broad bandwidth network system and anti-environmental instrumentation and control systems, which are difficult to make with conventional electric transmission systems.

Fig. 6 shows a basic configuration of a 10MB/sec fibre optic data free-way system for a large-scale distributed computer control. It consists of 3R (retiming, reshaping,regeneration) repeaters, fibre cable and node control, master control and intelligent stations. By adopting the duplex configuration of the control station (CST) and each acting as a backup for the other, a reliable optical fibre DFW system is realised. The master station is connected to the host computer. Its main functions are (i) transmission control for the loop systems, (ii) data transfer control, and (iii) high speed interface control to the host computer.

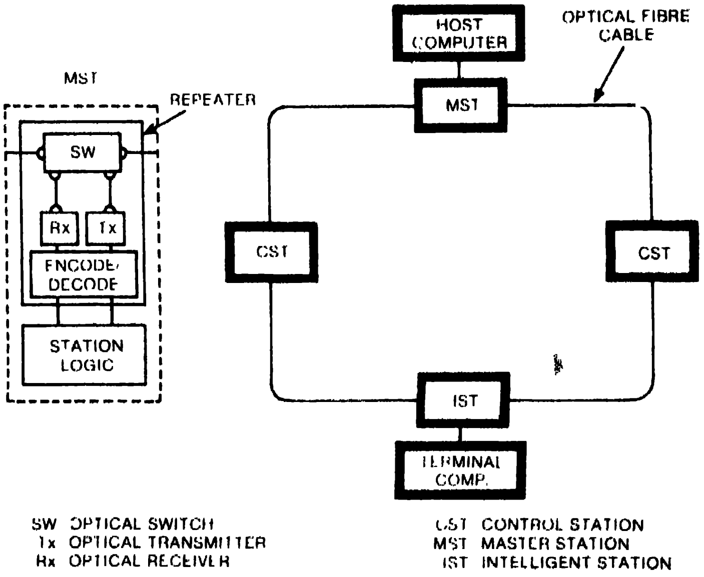

Fig. 6: Basic configuration of the DFW system.

The intelligent station is connected to a terminal computer. According to the remote command from the host computer, it performs the following functions:

1. Start, stop and reset function of the terminal computer.
2. Remote loading of data and programs (live or diagnostic) from the host computer.
3. Read-back function of programs in the terminal computers and RAS (reliability of availability and service) information.

Following are the system specifications:

1. Max. 225 stations/loop
2. Max. 2kms distance between stations
3. 10MB/sec transmission speed
4. Max. 512 bytes variable length message

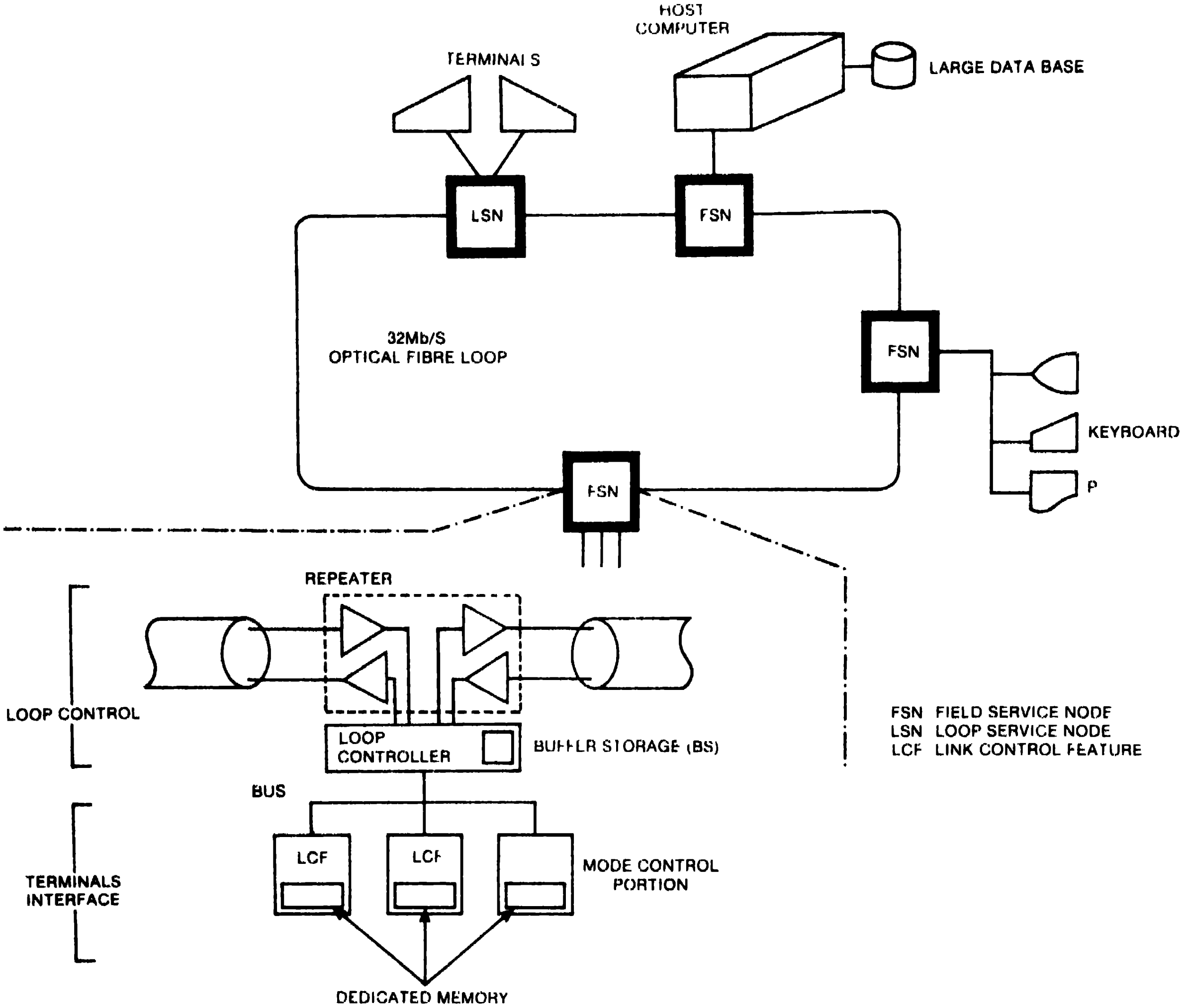

Fig. 7: System configuration of 32MB/sec loop network.

5. Automatic retransmission
6. Max. 900kB/sec channel throughput
7. 0-50°C operational temperature

Optical fibre loop network

Fig. 7 configures a 32MB/sec optical fibre loop network for application in production control, laboratory and office automation. It is a packet switching network which provides international standard packet interface CCITT × 25, to the terminals with following specifications:

1. Max. 126 nodes/loop
2. 100km max. loop length
3. Max. 2kms distance between nodes
4. NM communication mode
5. 32MB/sec transmission speed
6. Token access and loop answer method
7. LED emitter and PIN PD detector
8. 3dB/km optical fibre pair loss

Cost

There is a steady decrease in the price of cable, components and systems. Over a decade optical cable industry has experienced a 45-fold increase in the amount of cable used, and during the same period the cost of fibre cable has come down by 60 per cent. The cost of optical fibre cable is now competitive with that of copper cables.

As an infant technology, fibre optics is benefiting from the declining prices that accompany an early phase of industrial growth. It is expected that the costs of fibre optic cable and associated optoelectronics will continue to decrease at the rate of around 15 per cent a year. Copper transmission, a more mature technology, offers little promise of either advances in capabilities or downward trend in prices.

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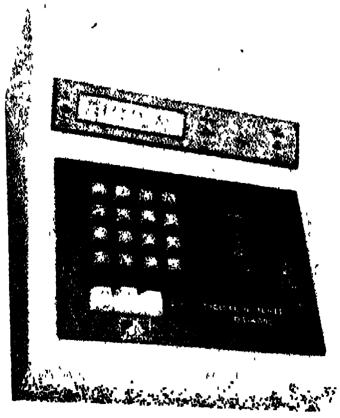

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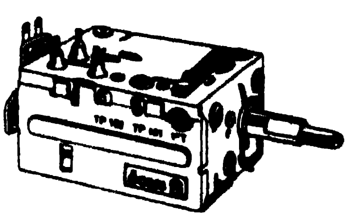

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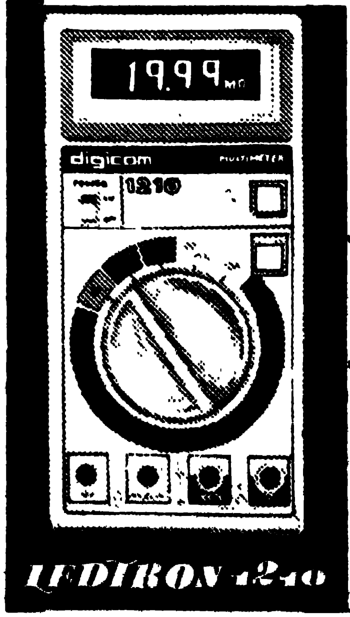

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CLEAN ROOMS

Precision tool of sophisticated electronics technology

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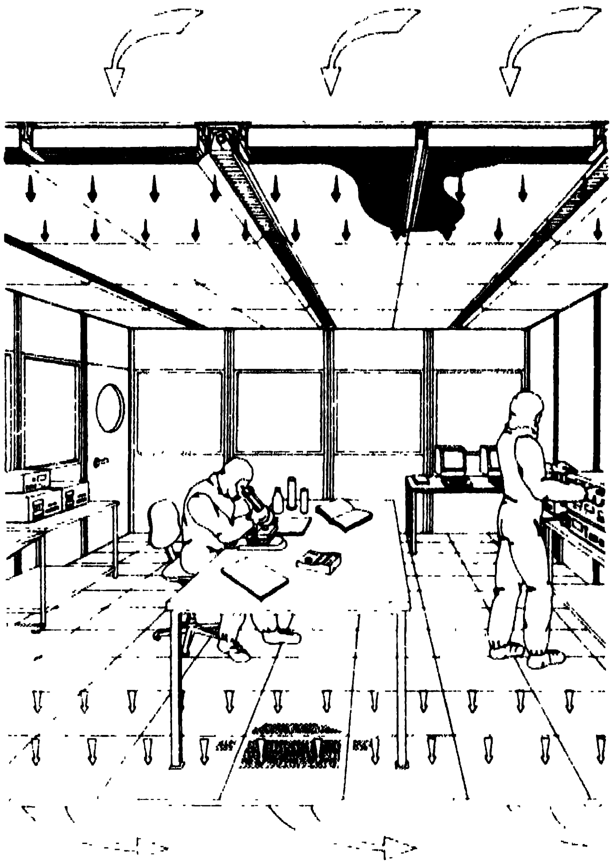

Clean rooms, once thought to be a luxury, have become the precision tool of sophisticated technology today. The electronics industry, right from the wafer fabrication to the final assembly of the printed circuits, has a common concern for quality control of the manufacturing process.

The airborne dust particles have disastrous effects on the final product in terms of yield and reliability. This calls for stringent requirement of environmental control. It must be appreciated that the magnitude of dust hazard is not the same for a semiconductor industry manufacturing ICs, transistors etc as that for the assembly of printed circuits. That is, the degree of cleanliness required is not the same in each of the processes.

The word cleanliness has taken a new dimension with the entry of the sub-micron technology in the electronics field. Even particles from the face powder or nail varnish from the operators present a real hazard in the miniature component fabrication and assembly.

The advances in control capability and contamination-free design have begun the age of clean room robots. The specially designed clean room robots will result in decreased particulate generation, minimised processing errors and increased process control and flexibility. This means a better yield and consequently more cost-effective production.

The effect of the contaminants in the electronic device fabrication is seen in degradation of the electrical characteristics such as open circuit, short circuit, low gain and even totally dead device. Again, in the final assembly of the circuits, the contamination may lead to low resistance or short between the multilayers of the printed circuit boards, hair line cracks, shorting or pin holes in the printed patterns. The extent of damage by the airborne contaminants, however, will not be of the same order as in device fabrication. Thus, in order to realise the inherent uniformity, low cost and reliability of electronic devices and circuits, the understanding of contaminant effects and their stringent control is a must.

Definition

The clean rooms are designated to a certain class if there are less than a corresponding number of 17.97 microns/ m^3 (0.5 micron per cubic foot). This follows from the federal standard 209B, titled 'Federal Standard Clean Room Work Station Requirement Controlled Environment'. That is, a class 100 clean room will have less than 100 particles larger than 17.97 microns/ m^3 (0.5 micron/cubicfoot), a class 1000 less than 1000, and so on.

With the emergence of the ULSI (ultra large scale integration) and VLSI (very large scale integration), the requirement of cleanliness of the order of class 10, class 1 or even

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class 0 have become necessary. The classifications are being based on the extrapolation of 209B standard. But no official standard has yet been developed and the federal standards developed in 1960 for aerospace industry and revised in 1976 are once again under revision for a new definition for ultra-clean rooms.

Identification and measurement of airborne contaminants

The major contribution to the airborne particulate deposition in a factory environment is sedimentation, but the process becomes complicated by the effect of brownian diffusion, coagulation, inertia, turbulent flow, artificial agitation and other secondary forces. Gravity is, of course, the most commonly recognised mechanism for particulate movement and deposition. These deposited airborne particles have to be measured and identified for their effective control.

The examination of the product surface and the environment for the presence or absence of particles is the most direct type of measuring method. Visual examination with the aid of a microscope can provide not only quantitative information but can often lead to direct identification of the type of particles present. Such identification of particles is the first step in elimination of their source.

The simplest technique is to permit the particles to settle from the environment by gravity on a clean substrate, preferably glass, and analyse. This process however does not represent all particles existing in the environment air since only the larger particles (> 5 microns) tend to settle down on surfaces within reasonable time. The time required to collect an adequate sample may be anywhere from two hours to several days, depending on the cleanliness of the working environment. Secondly, this technique tends to collect particles generated by people and processes in the immediate vicinity of the sampling spot. Of course, the sample is more typical of what the product sees, but not necessarily typical of the environment surrounding the product.

To quantify the finding, the sizing of particles using the microscopic method require the definition of a standard dimension of measurement. The ambiguity arises as the particles are irregularly shaped. For a particle shaped like a peanut, the conventional sense of diameter has no meaning. However, the word has come to apply to a measurement of such particles.

The most widely accepted diameter is the Martin's diameter which is the length of a line which divides a particle into two equal areas. The other, the Feret's diameter, is the length of a line drawn between two parallel tangents on the particle (Fig. 1). However, some constant direction must be chosen to measure the diameter.

Several other diameters have also been employed over the years and appropriate graticules and reticles have been fashioned for their estimation. Such diameters are often termed as statistical diameters because a large number of them must be measured and averaged before they become meaningful.

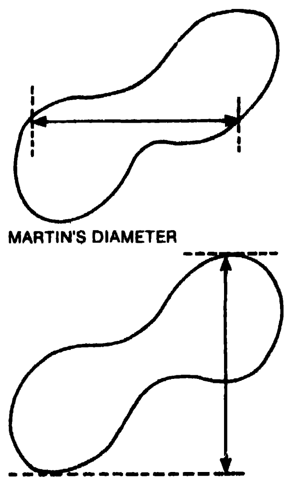


Fig. 1: Particle diameter definition.

The microscopic method can be both manual and automatic to some degree. In the automatic technique, the image analyser can count and measure number, area, some type of defined length, shape, optical density and perimeter with high speed using a sophisticated electronic system.

The most popular electronic particle counters are capable of performing in situ measurements. Light-scattering particle counters can instantaneously measure the airborne particles down to 0.3 micron. This technique provides only a secondary indication of surface cleanliness. It must be assumed that if a product is exposed only to a clean environment, the number of particles deposited on the product surface from the environment will be nearly zero. The limitation of this technique is that the integrity of light that is scattered by a particle depends to some extent on physical characteristics other than size, viz, the shape, colour and index of refraction.

Again, since particle counting instruments measure only the particle in a relatively small volume of air, the statistics of sampling can be applied to the resulting data. The statistical error is equal to $1/\sqrt{n}$, where n is the number of data. It is evident that 100 particles of a given size must be counted in order to reduce the error to ±10 per cent. At a class 100 condition one cubic foot of air must be sampled to achieve the ±10 per cent error. Hence, it follows that cleaner the environment, the larger the air sample that must be sampled for a given statistical accuracy.

The minimum particle size detectable with light-scattering instrument is about 0.3 micron because of electronic signal-to-noise ratio limitations. However, counters have been developed for measuring still smaller particles by indirectly determining the electrical mobility of a charged aerosol.

Design considerations

The required cleanliness in the clean room is achieved by a number of techniques. One technique is the exclusion of the contaminants from entering the environment either by filtering of the incoming atmosphere or isolating of the surface from the hostile environment. The principle of dilution can be used by passing contamination-free air through the given space in sufficient quantities to remove the contaminants generated within the space. Further, air distribution design prevents or atleast minimises the recirculating eddy currents. The reduction of contaminant generation within the space by both process and personal control is another way. Lastly, since contaminant deposition from the environment is time dependent, the advantage of this fact is taken by reduction in the time of exposure of the contaminant-sensitive surface. These techniques are judiciously used to control the airborne particulate matter.

Most clean rooms of higher order have 80-100 per cent ceiling coverage with high efficiency particulate air (HEPA) filters and lights which are designed for free air-flow. The vertical flow type rooms have a false ceiling on top housing HEPA filter in an air handling duct and pre-filters under the floor grating. The air handling units are provided on the sides in the plunum provided false ceiling (Fig. 2).

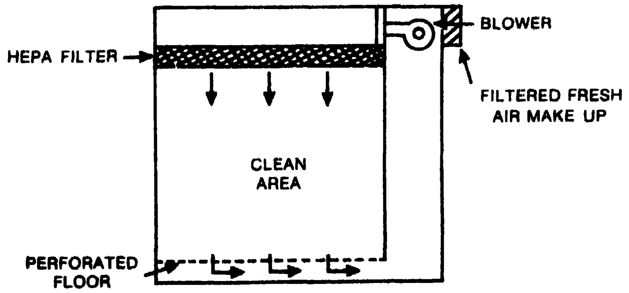


Fig. 2: Vertical laminar flow room.

In the horizontal wall-to-wall flow arrangement, a bank of HEPA filter on one side and pre-filters on the opposite side are fitted with the air handling unit and ducting on top inside plunum. In this laminar air distribution system, the flow of air column is almost in a parallel beam. The horizontal type assumes highest or desired cleanliness for the first line of work position only, while in the vertical laminar flow system it is possible to achieve the required cleanliness over the entire area (Fig. 3). The air-velocity in the laminar flow system is kept at 90-100 fpm.

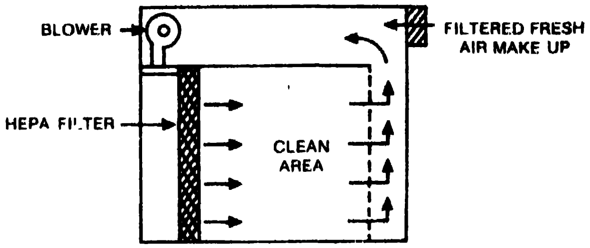


Fig. 3: Horizontal laminar flow room.

Further, the clean rooms are maintained at a positive static pressure differential by proper air distribution with respect to the non-clean or relatively less cleaner areas. The make-up air added to the clean room is pre-filtered to at least the same degree of cleanliness as the recirculated air. For small volume of rooms the fresh make-up air may be 5 to 20 per cent, but in rooms utilising a high volume of recirculated air, the fresh make-up volume should be decided on the number of operators working and calculated as 8.4948 m³ (30 cubic feet) per minute per person. However, while deciding the fresh air make-up volume, the exhausted air due to chemical vapours should also be taken into consideration (Fig. 4).

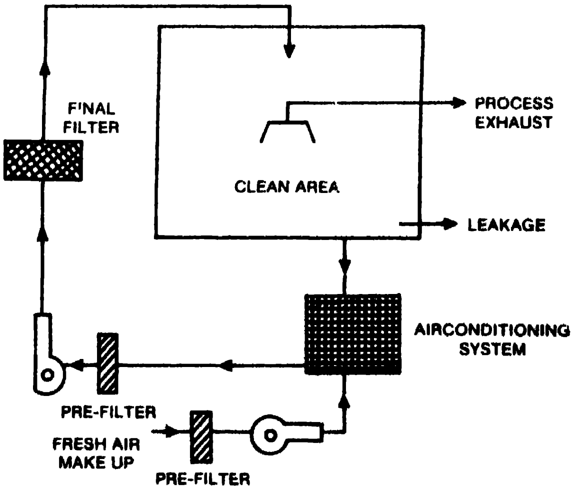
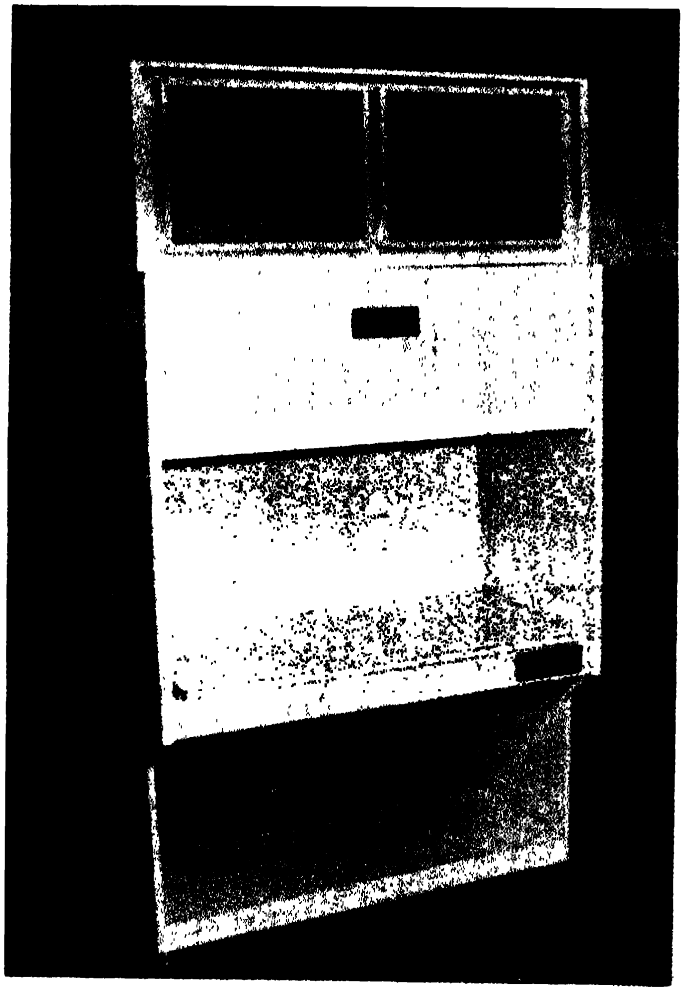


Fig. 4: Schematic of air handling system.

The selection of the right type of material for construction of clean rooms is very important. Materials which are liable to generate, harbour or attract foreign particles or fibres or need finishing or contain contaminants which through handling may be passed on to the product or released into the environment, should be avoided.

The room flooring of PVC material welded at the joints and covered at edges to seal the flooring to the partition are



Vertical laminar flow bench: courtesy Clas Laminar Systems.

of importance. For illumination, a translucent cover over fluorescent lighting gives a good diffused light with pleasing appearance and at the same time heat and maintenance are kept outside the controlled area.

Filters used for filtering the particulates are made of glass fibre/esparto glass paper type or electrostatic collector type. The electric filter works on the principle that dust particles drift towards the ioniser with a very high electrostatic charge. These particles, carrying very high potential positive DC charge, are made to pass through collector cell comprising positive and negative plates. These collector plates maintain constant electrostatic collection forces for stable operation. The collected dust/fume particles adhere firmly to the plates.

The glass fibre filters have a very high degree of efficiency and are also called absolute filters or HEPA filters. However, the pressure drop across this filter is greater than the electrostatic filter. Fibrous dry filter or viscous wet filters are used as pre-filters. The filter life depends on the location of the installation, operating conditions, efficiency of the pre-filters and season of the year. Electrostatic filters have the advantage of being reused after cleaning whereas the HEPA filters require replacement.

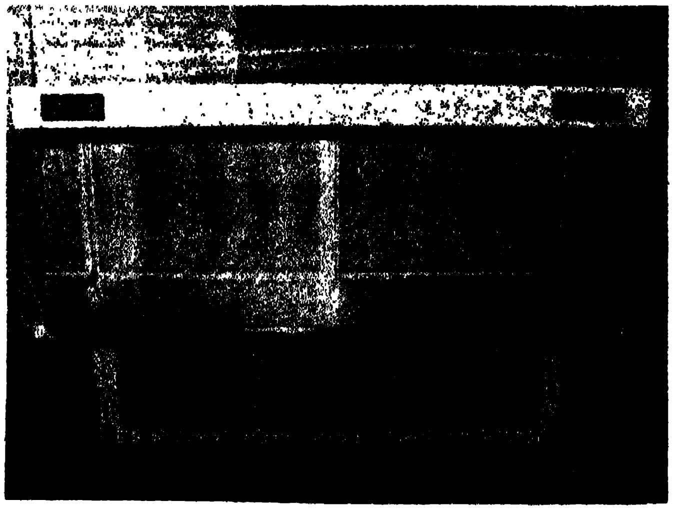
The ability of HEPA filters to provide particulate-free environment is tested by the DOP (dioctyl-phthalate) penetration test. By definition, an HEPA filter must demonstrate a minimum collection efficiency of 99.97 per cent for 0.3 micron thermally generated DOP dust cloud and a maximum clean filter pressure drop of 1.0 inch w.g. at its rated air flow capacity. This test is intended as a measure of the filter's ultimate ability to capture particles of any size at a practical operating pressure.

The other standard for testing is the British standard methylene blue test. A filter having a penetration of 0.03 per cent by DOP has a penetration of 9.95 per cent by methylene blue test. This indicates that methylene blue testing is more searching. The methylene blue cloud has particles ranging from 0.01 to 1.3 microns, the mean size being 0.5 micron. The aerosol produced by DOP has a mean particle diameter of 0.7 to 0.9 micron.

Clean room accessories

A number of peripherals are used to increase the efficiency of the clean rooms. The air shower or man cleaners are normally used for personnel cleaning before their entry into the clean area. The person stands in a closed cubical and is subjected to high velocity clean downward and sideward air flow. The air brushing action is obtained from the jets placed in the walls and ceiling. The air jet ensures that the scavenging air reaches the clothings of the person at the correct angle and sufficient force to dislodge the dust particles from the clothings. The particles are skidded off and not driven into the texture of the clothing. Once the particles are airborne they are trapped by the dust traps.

Normally, air showers are interlocked and only one door can be opened at a time. They also act as a buffer air lock between the clean areas and relatively lesser clean areas. Often a small room attached to the clean room preceding the air shower is used. This room maintains a positive static pressure between the clean areas and the outside hostile environment.



Horizontal laminar flow bench: courtesy Clas Laminar System.

For control of foot-borne dirt or contaminants, tacky mats with a special pressure-sensitive surface to pick-up dirt and dust from shoe soles and heels are used. Air curtains mounted at the entrance of the air lock acts as an invisible dust and temperature barrier by a down flow of filtered air.

Process materials from and into clean areas are taken through a small enclosed chamber with interlocking doors. Called pass box or hatch, it helps to limit traffic into the clean area. Similarly, the communication between clean areas and outside world is accomplished by electronic intercoms or speak-thrus. A speak-thru is a small device with a thin diaphargm which permits one to talk and listen with the diaphargm acting as a barrier between the clean and hostile environment.

Garments

Garments used in the clean rooms also call for special attention. Lint-free dacron, nylon and polyester garments are used by the personnel for prevention of particulate contamination and to confine the innumerable biological fall-outs shed by the operators. If nylon overalls are to be used, some means have to be provided to de-ionise the garments, thus making them non-electrostatic. The head covers must fit snugly and yet be comfortable enough to be worn for long periods of time. Use of gloves prevents skin flaking, perspiration and skin oils contaminating the product. Shoe covers must be of tightly woven fabrics to impede the passage of dust and dirt.

Cleaning mops used in clean areas should be highly absorbant polyurethane foam sandwiched totally between dacron covers. Dacron is preferred as it has low retentivity to static charges. To make the garments antistatic, an antistat chemical is dissolved in the final rinse water while washing the garments. On drying the garment, the antistatic chemical adheres to the fibres. This chemical has the property to pick-up moisture from the air and helps to reduce the static electricity. It is a surface agent and the quantity used decides the static reduction power. However, large quantity used will be more harmful as it is likely to flake in the clean areas during use.

The present trend is to use garment with silk texture polyester with an interwoven carbon thread for making them static-free. The garments need to be carefully designed. They should be fitting to eliminate abrasion against underneath clothing and thus avoid contaminant fallout. All seams should firmly envelope the raw edges of the material. The fabric must be tightly woven to minimise passage of dust and lint from the person's body and inner clothing to the outside.

Summary

The importance of contamination control is not confined to the field of electronics but also in the manufacture or repair of space vehicles, human surgery/transplantation of organs, drug manufacturing, food processing and many other applications which are poles apart in their similarity. Even in these diverse industries, the method of contamination control has the common approach. It is quite unusual to think of the human body as a product or an operation theatre or as a factory but the engineering principles of manufacturing environmental control are applicable.

The control of infectious micro-organism in hospital operating theatres can be achieved in a manner identical to one used to protect airborne particles damaging the pattern generated in the electronic device fabrication. The only difference one can think of is that the human body will become infected due only to living contaminants or germs, while an electronic device can be 'killed'.

The study does not end here. Even a particle of a few microns can prevent the correct functioning of a delicate gyroscope mechanism. With every stride the mankind makes in any field, the word 'cleanliness' takes on a new dimension.

The design and construction of clean rooms to meet the demanding needs of electronic component manufacture and assembly is a complicated and costly task. The state-of-the-art expertise has to be incorporated to analyse and understand the specific requirements for a tailor designed clean room. A successful design must consider the features as process flow, operator flow, safety and above all cost effectiveness. It may be concluded that the clean room system is not a luxury as it justifies the system cost in terms of the high yield and reliability of the product. ☐

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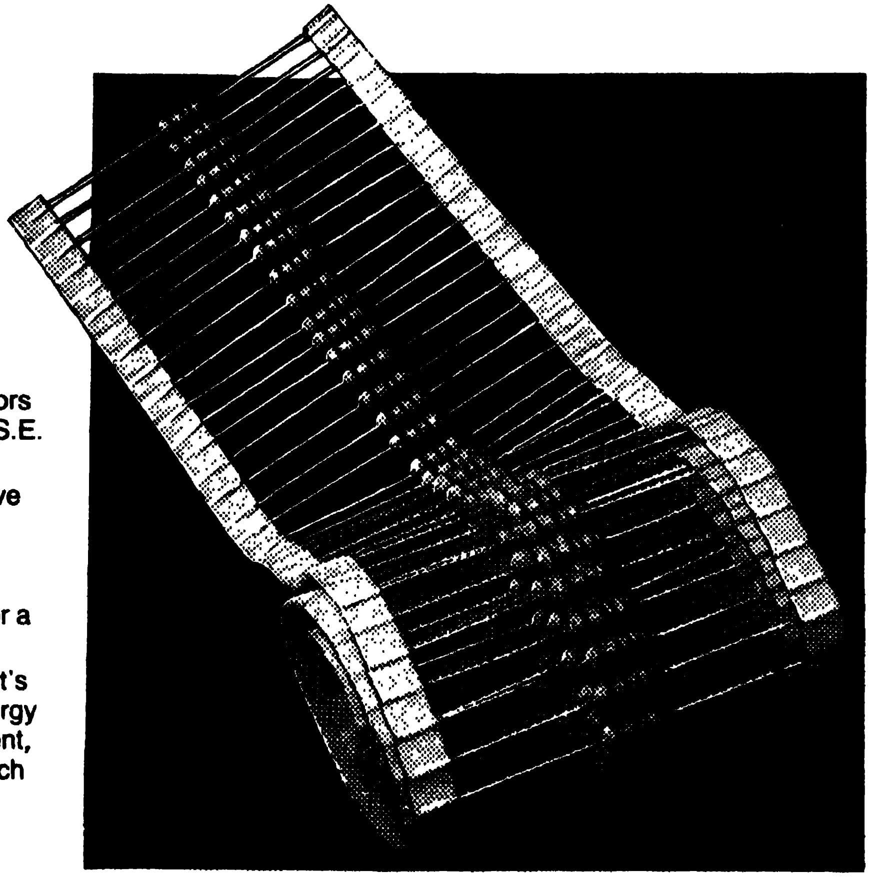

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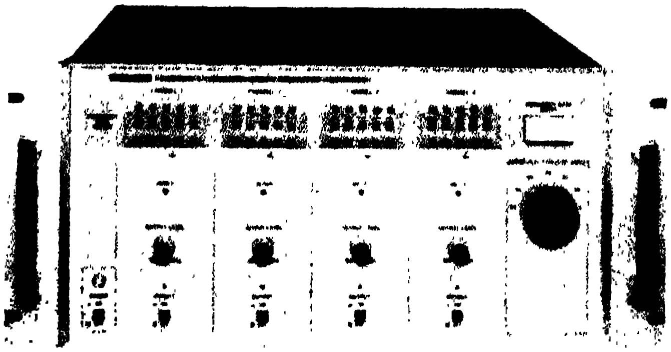

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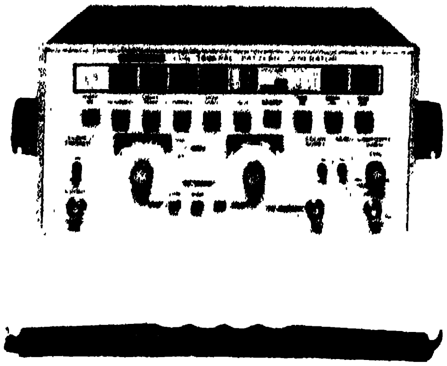

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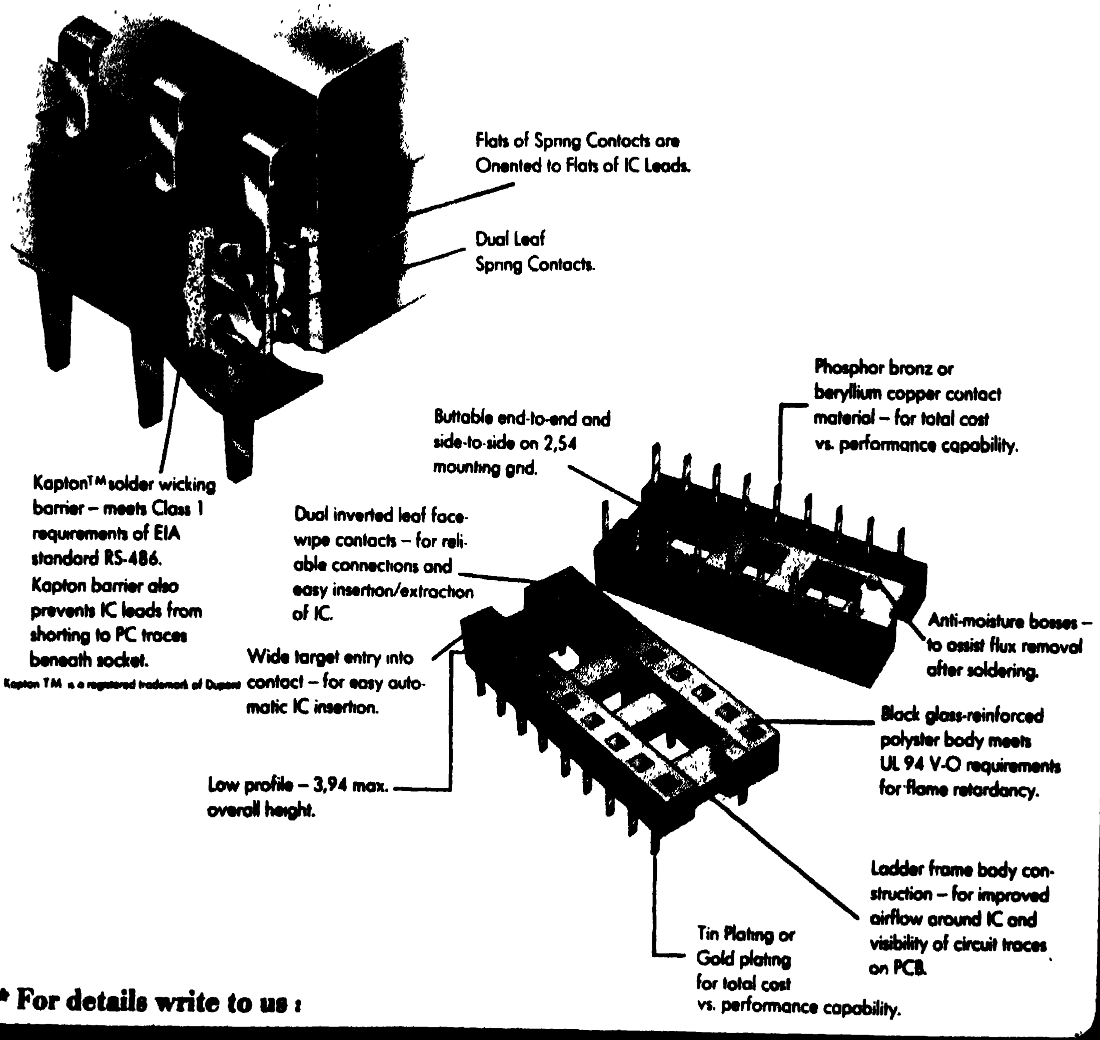
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Photolithographic Techniques for LSI and VLSI

Part II

J.D. Jain and A. Srivastava

Pattern replication with the help of relatively short wavelength light and using contact printing has been the common practice in IC manufacturing for years. However, the mask life and high defect density limit the usefulness of the technique.

X-RAY LITHOGRAPHY

Projection printing with deep ultraviolet rays has removed the problems to a great extent though diffraction, standing waves and scattering effects limit the minimum resolution and line width control. These problems have been eliminated by using X-rays whose wavelengths (4 to 50 Å) are several orders of magnitude smaller.

Physics of X-ray generation

When an electron from an electron gun, strikes the target atom (Fig. 4), it may eject an electron from an inner shell of the target atom. The resulting vacancy is then filled by an electron from a higher energy level of the atom. In dropping from a higher to a lower energy level, the losing energy from the electron appears in the form of electromagnetic radiation. The energy of this electromagnetic radiation is equal to the difference of the two energy levels. Since this energy difference is fairly large in the inner shells, the radiation is in the form of X-rays.

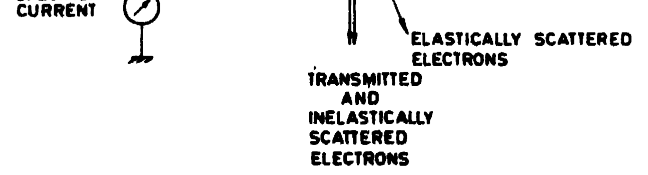

Fig. 4: Schematic representation of principal components of the interacted electron beam with a specimen.

As there are many energy levels within every atom, the vacancy filling mechanism may occur between different levels and X-rays emitted at different energies. All electromagnetic radiation can be classified according to its wavelength and at the same time also considered as packets of energy called photon. A simple relation between them can be described mathematically as

$$\lambda = \frac{h\,c}{E}$$

where λ is the wavelength of the radiation, c is the velocity of light, h is the planck's constant, and E is the energy of the radiation. If E is measured in KeV and wavelength expressed in angstrom, by substituting the values of h and c, the above equation can be simplified to

$$E = \frac{12.4}{\lambda}$$

If the primary electron interacts with the nucleus of the sample atom, it may also be scattered inelastically by the coulomb field of the nucleus (Fig. 5), thus giving up some or all of its energy. This energy may be emitted in the form of continuous X-rays (also known as 'bremstrahlung'—a German word meaning breaking radiation).

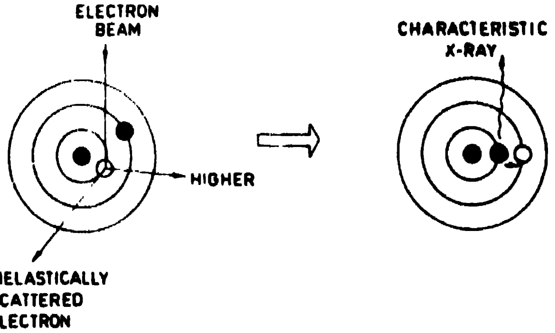

Fig. 5: Physical principle of X-ray generation.

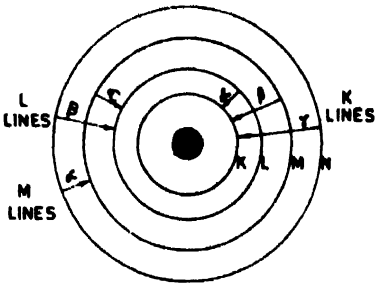

Fig. 6: Some line types typically observed in the X-ray spectra.

Classification of X-rays

The energy packets (lines) are usually named according to the shell in which the initial vacancy occurs and the shell from which an electron drops to fill this vacancy. For instance, if the initial vacancy occurs in K shell and this vacancy is filled by an electron from L shell, the X-ray emitted is denoted by K α (Fig. 6). If the electron drops from M shell, the emitted X-ray is designated by Kβ.

X-ray generators

X-rays are generated in an evacuated area (Fig. 7) by accelerating electrons (from few KeV to tens of KeV) from a heating filament to hit a metal anode (target) made of, say, tungsten, ionising some of the atoms by inelastic scattering of inner shell electrons. The excited atoms of the target decay to ground state passing through intermediate steps, losing energy at each step.

In some steps, this decaying energy produces X-rays whose wavelengths depend on the atom's energy level before and after the step. Additionally, when the electrons are decelerated by the target atoms, they radiate energy in the form of continuous X-rays.

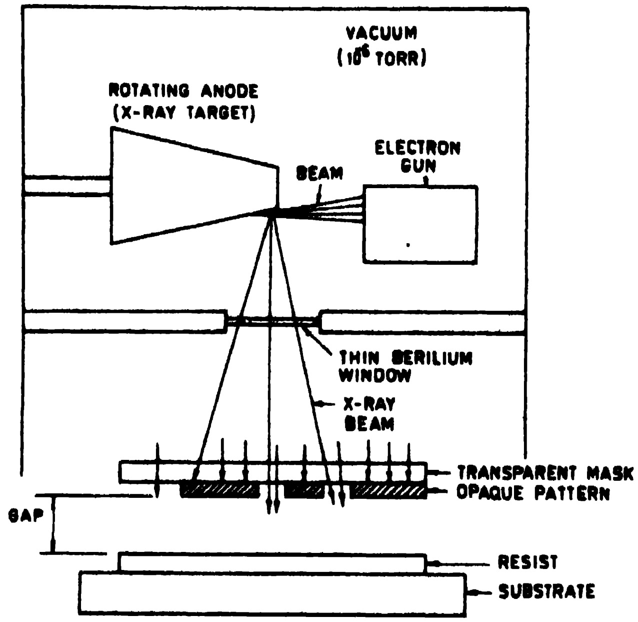

Fig. 7: Schematic of a X-ray exposure system.

The wavelength of the X-rays is in the range: 0.05 Å to 100 Å. The lower side may overlap with γ rays and the higher side with ultraviolet radiations.

X-ray's spectral region of interest

The portion of X-ray spectrum from 4 to 50 Å (also called as soft X-rays) is useful for X-ray lithography. There are only two variables that can be adjusted to control the spectral energy distribution: anode material and electron energy. The anode material is usually selected to make the mask contrast high corresponding to a particular X-ray wavelength. The electron energy is chosen to maximise X-ray yield, defined as the power in the X-ray beam divided by the power into electron beam. The efficiency of X-ray yield is approx. 1 per cent. The rest is converted into heat. Due to relatively short wavelengths, diffraction effects are greatly reduced and allow for the replication of patterns with mask wafer gaps as large as 40 microns.

In practical X-ray systems, the source spectrum, mask transmission and the resist absorption, all have to be optimised with respect to each other for minimising the exposure time and maximising the mask contrast.

X-ray lithography is a method of proximity printing. It is a shadow printing technique and basically similar to optical proximity printing.

Mechanism of resist exposure

To understand the function of mask and resist, it is first necessary to understand the characteristics of X-ray propagation in materials.

X-rays move essentially in straight lines. When they fall on a material (resist) they eject a photoelectron from the atom constituting the material. The energy of the photoelectron is equal to the initial energy of the photon minus the binding energy of the electron with the atom. The direction of the photoelectron emission is similar to the direction of the photo trajectory, i.e. in the plane of the resist. The cross-section for capture by an electron in a given atomic shell varies with the photon wavelength and exhibits large jumps at critical wavelengths.

The resist material is most transparent when the X-ray wavelength is slightly longer than the critical wavelength and most opaque when it is shorter. The useful range of the X-ray wavelengths are from 4 - 50 Å .

The photoelectrons travel in the resist scattering and exposing it. The excited atom returns to its ground state and emits X-rays which are further absorbed by nearby atoms, repeating the process. The incident photons transfer the energy to the atoms producing a flood of photoelectrons which actually expose the resist.

Electron guns

The basic requirement of any electron gun is to provide a high current density at relatively low voltages. Two types of electron guns in common use are: (i) pierce gun, and (ii) ring gun.

Pierce gun has a very simple construction and, if properly designed, it can give current densities of the order of 3 A/cm^2 at 15 kV. But it has two main limitations:

1. Evaporation of filament material contaminates the anode if the anode is in the line-of-sight position from filament.
2. Non-uniformity of the electron beam spot causes premature failure of target. If the design is not of the line-of-sight nature, hot spots may be caused.

The ring gun has a preferred geometry such that the ring filament can be shielded or located below the anode surface so that the contamination of the anode can be avoided. Since the ring structure has a large emitting surface, the hot spots can be controlled easily.

Both pierce and ring gun structures can be provided with an electrode to control the emission current.

X-ray targets

X-ray power produced is limited to the ability of the target to dissipate the heat generated due to bombardment of electrons. In order to dissipate this heat, anode are rotated and simultaneously cooled forcibly. Two types of X-ray targets have been in use: rotating and stationary.

Rotating anodes are used in high power X-ray tubes. But the rotating mechanism causes some problems such as the limited life time of vacuum seal for rotating anode and unwanted vibrations to wafer.

The stationary anode offers greater reliability but the maximum power is limited by the method of target cooling. The target materials play an important role in the generation of X-rays of particular wavelengths.

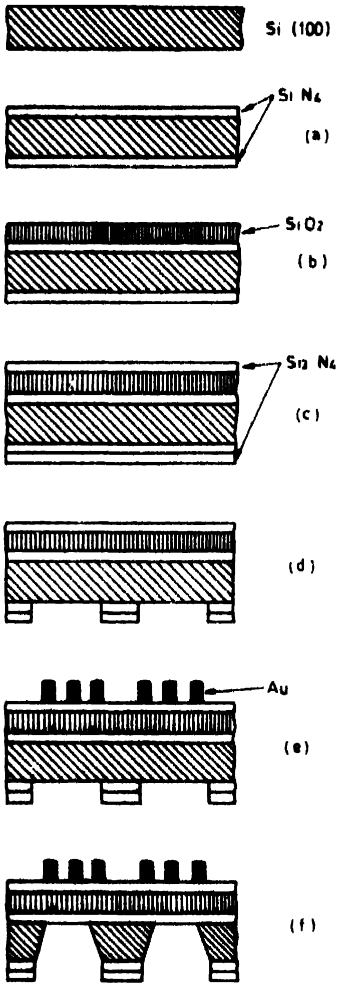

Fig. 8: X-ray mask fabrication steps.

Target materials

From the limited number of materials that emit characteristic X-rays in the range 4-9 Å wavelength, five are most suitable for X-ray lithography. These are aluminium (K α : 8.34 A^0), silicon (K α : 7.13 Å), molybdenum L α: 5.41 Å) rhodium (L α = 4.60 Å) and palladium (L α :4.37 Å).

Plated targets could be used in the case of costly materials like palladium instead of solid targets, but these suffer from inter-diffusion and cracking problems.

X-ray sources

The two types of sources used in X-ray lithography are collimated and point sources.

X-ray sources can be divided into two categories: conventional and unconventional sources. Each may produce collimated beams or act as a point source.

Conventional sources are those in which X-rays are generated by striking high energy electron on a metal target. The success of such sources depends on three major components: (i) X-ray target and method of cooling, (ii) electron gun, and (iii) X-ray output window

The efficiency of the conventional source is of the order 10^{-4} W/W. This means that if a 2.5kW electron beam produces 0.5 watt of AlαKX-rays, then the efficiency will be equal to 2×10^{-4} W W.

Other sources

Laser heated plasma. In this sytem, laser beams are focused on a target heated to millions of degrees kelvin.

Synchrotone source. Synchrotron radiation from electron storage ring is a very promising device as X-ray source. This results from electrons radiating as they undergo radial acceleration in the bending magnetic fields that confine them to orbits in a ring. The beam emerges as a well collimated wide beam; hence large masks-substrate gaps (about 40 micron) are possible for adequate exposure uniformity.

The high X-ray flux from storage ring provides the possibility of short exposure time (≈ 1 min) using thick layers of resist, and hence offers the advantage of high throughput and process simplicity. The other advantage of synchrotone source is that it can be tuned, i.e. the peak wavelength can be shifted by changing the energy of the stored electrons. By proper tuning and filtering out selected wavelengths by passing through certain materials, it is possible to get very good lithographic results.

Sliding spark device. In this device, an electrical discharge in a capillary produces a mostly carbon plasma that is struck and heated by an intensive discharge initiated electron beam. The highly ionised carbon atoms emit a large flux of X-rays over a band from 4.4 nm to 60 nm. This technique is still at the experimental stage, but it seems promising as it may reduce the exposure time considerably.

Output window

A window of transparent material for X-rays is essential to isolate the vacuum chamber from the source side to the gases surrounding the mask. Berrillium is most commonly used as a vacuum window because it has sufficient strength to withstand pressure differences between source to sample environments and has very low absorption of X-rays. Berillium transmits X-rays from elements with atomic numbers 11 and greater. X-rays with energies greater than 2 KeV are transmitted with nearly 100 per cent efficiency.

The thin Be window allows the beam to be filtered, by removing unwanted spectral components and by stopping scattered and secondary electrons before they strike the mask or resist. The choice of the window material is very important in optimising the performance of X-ray lithography and system. A window made of the same material as the target (anode) will pass only the line emission.

Here it is important to define the absorption edge of a material. As a X-ray travels through the sample, it may be absorbed, giving up its energy entirely to an electron and ejecting it from its orbital. The likelihood that an X-ray will be absorbed in such a process depends on its energy and the energy with which the electron is bound to its nucleus. The probability of absorption increases as the X-ray approaches this binding energy from above and reaches a maximum when X-ray energy is just greater than the binding energy. At this point, there is a discontinuity- an absorption edge --in the probability curve.

All materials have their characteristic wavelengths (absorption edges) which is slightly longer than their line emission wavelengths. Let us take an example to explain the importance of the window material. If the opaque portions of a mask absorbs line emission then that portion of the mask will get heated up and get distorted, reducing the life of the mask. A window of the same material at the mask will absorb this unwanted spectrum so that the mask will not get heated up.

X-ray masks

One of the key factors in X-ray lithography is the construction of the mask. The mask essentially consists of absorbing patterns over a thin transparent material. The membrane is usually a few microns thick.

Besides being highly transparent, the membrane should be flat, smooth, self-supporting, dimensionally stable and mechanically tough to withstand the handling hazards during fabrication. The membrane should also be optically transparent so that optical mask alignment procedures can be used.

The thermal expansion properties of the mask and wafer must match. Photoelectrons generated on the mask materials should be prevented from reaching and exposing resist. Optically transparent masks can be of organic or inorganic materials.

Organic membranes are superior in flatness, smoothness, have high chemical resistance and dimensional stability but are poor in strength. Hence they cannot be big in size (not more than few mm square). The organic materials may be polymer films like mylar or polymide while the inorganic materials may be films of Si_3N_4, Al_2O_3, SiC etc. The membranes may also be a combination of organic and inorganic films such as BN/polymide—the latter having been tried successfully. X-ray mask fabrication steps using inorganic material are shown in Fig. 8.

Widespread use of X-ray lithography will depend on the versatility of mask fabrication.

Resolution and overlay accuracy

As mentioned earlier, photoelectrons and secondary electrons, which are emitted due to falling of X-rays on resist, expose the latter. The range of these emitted electrons plays an important role in the resolution. Higher energy photons produce less distinct pattern edges.

A gap, say 'g', is introduced between mask and resist to avoid damage of the mask. If this gap is increased to, say, to tens of microns, fresnel diffraction effects at the pattern edges will expose the resist in a way that sharpness in demarcation will be affected. It is the trade-off between X-ray diffraction and secondary electron range that sets the ultimate resolution in the X-ray lithography near 50 Å wavelength as the higher side.

Another component which affects the resolution is the manner in which the masks are made. For any given mask material, the spectral distribution of energy in the X-ray source and the minimum acceptable mask contrast, there is a minimum pattern width that can be replicated.

In addition to this, the geometry of the sources, i.e. whether the source gives a collimated beam or is a point source, also sets the resolution and alignment limits.

Absorbers

Gold is the most frequently used material as absorber since (i) it has a relatively large absorption coefficient, (ii) it is easy to coat and pattern, and (iii) it is inert--assuring long mask life. A thin layer of refractory material, such as chromium, is applied on the membrane prior to the gold coating to promote adhesion.

Future trends

Widespread use of the X-ray system will depend on the development of economic good emission sources, X-ray filtering materials for windows, high contrast and thermally stable masks—all to be optimised in a practical system. It is hoped that 0.1 to 0.2μm overlay accuracy could be achieved.

X-ray resists

X-ray resists have received lesser attention than E-beam and consequently suffer many problems, although it is known that all E-beam resists are also being used as X-ray resists.

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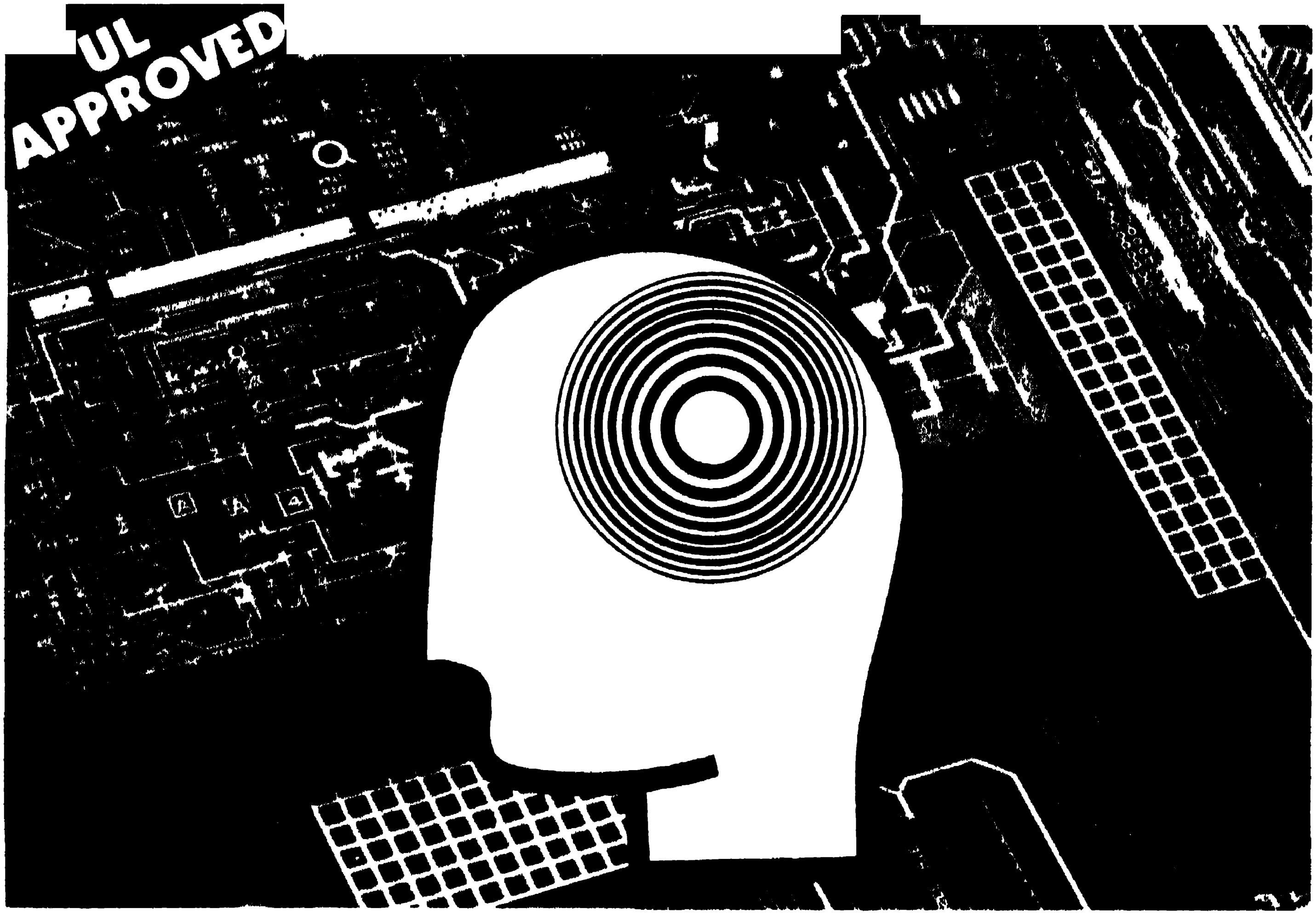

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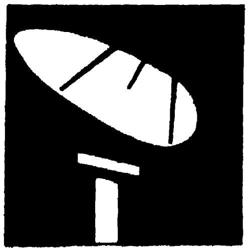

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Computer Corner

Computers enhance state revenue in Haryana

The introduction of computers in Haryana government departments has resulted in large savings besides improving efficiency and accuracy. For example, in the local Panchkula office of Haryana Urban Development Authority [HUDA], an outstanding of Rs 3.8 million was detected in just one sector alone after switching over to computers. Again, Ambala Municipality water bill recoveries have shot up by 20 per cent. In fact, the impact of computers has been felt at all levels in the state.

Computers have made their advent in state government operations through the Haryana State Electronics Development Corporation Limited [Hartron]. The state government has embarked upon an ambitious programme to introduce computerisation in all its departments and undertakings. Accordingly, the computerisation has already been introduced in HUDA, Integrated Rural Development Programme [IRDP], Haryana State Industrial Development Corporation [HSIDC], Haryana Dairy, Faridabad Complex, Ambala Municipality and the Health Department.

In line with the decentralised planning approach of the state and central governments, Hartron plans to set up computer systems in all districts of the state in a phased manner. A multi-terminal, time sharing computer at Ambala is already operational. Another system is in the process of installation at Gurgaon. It is planned that during the current year, at least one activity in each department of the state will be computerised. Further, during Seventh Plan, all the 12 districts in the state will have computer centres which shall be interlinked with each other through a central computer at the capital. The central computer to link the state government with the rest of the country is being procured with assistance from the government of India to form a part of the national network.

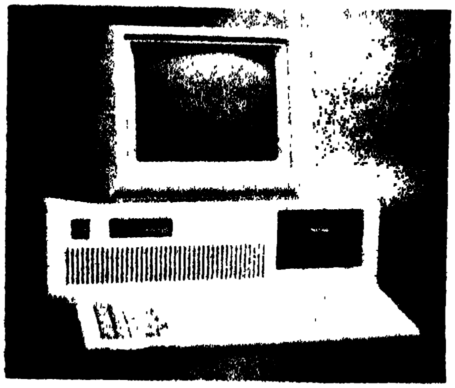
In order to further spread the computer culture, several training programmes are being conducted by Hartron. One such training course of one-week duration was held in the third week of June at Ambala. A six-month training course in programming was begun in July 1986.

Aurelec introduces 16-bit computer

Aurelec Data Processing Systems recently celebrated the sale of its 1001st computer with the introduction of a new 16-bit machine based on the advanced 80286 microprocessor, 2AT6.

This new computer, which is PC-DOS, IBM AT and PC/XT compatible, comes in a number of possible upgradations. It will run many of the programs written for the IBM PC up to three times faster. It has a large information handling capacity, with well over 3 million bytes of user memory if required. Multiuser, multitasking applications thus become possible. It also gives access to the fastest growing program library in the software industry.

Aurelec—with its partner Zenith Computers Limited, Bombay—has been known primarily for its 8- and 16-bit 'Orion' series of computers. Since its inception in 1980, the company has doubled production year after year. A major factor in this growth has been Aurelec's record of dependability. Each new system introduced has been as compatible as possible with every other machine in its range. Thus none of its computers have become outdated.



Aurelec's 2AT6 computer.

Extending beyond the immediate range of individual computers, Aurelec is also well known for its highly successful, proven, local area network, which is able to link tens or even hundreds of users within a building complex or a campus. The network allows full sharing of peripherals like hard disc drives and printers, and operates at a very high speed [2.5 megabit/second]. PCs can be interfaced with other Aurelec systems by means of the LAN; and CAD configurations can be offered, making it an excellent system for firms involved in engineering, design or architecture.

CAD system for planning layouts of buildings

Sigraph-CAD-WP from Siemens [W. Germany] greatly enhances the speed of planning without any loss of quality of drawings in architecture, interior design, building services and building design analysis. The hardware for this user package is the Sicomp WS 10 workstation.

Both the hardware and the software are designed for use in small planning offices and in the planning departments of large industrial firms, banks, architects' offices, office furniture companies and planning authorities.

Siemens CAD system for planning and layouting of buildings.

The components are within the reach of smaller offices. The consistent modularity of the system makes it possible to start with a basic configuration and upgrade step by step. Input devices offered by Siemens are an optical mouse and a digitising tablet. An integral evaluation module is available for analysing quantitative and qualitative data for construction and installation planning.

Powerful expansion modules for further processing of the data for architectural works with regard to building design analysis, building service engineering and flow of materials are also available.

Production prospects of computer printers

Various types of computer printers such as dot matrix, daisy wheel, ink jet, line, laser etc are available today. Although the dot matrix printer used with minicomputers enjoys the largest market, the daisy wheel is emerging as the printer of the future. At present, the requirement of printers in India is largely met through imports, though several companies with foreign collaboration have acquired letters of intent.

Popularisation of computers and office automation are expected to greatly influence the demand for printers. The demand estimates for 1987 and 1990 are:

[In numbers]

Printers needed	*1987*	*1990*
Dot Matrix	*13,500*	*55,000*
Daisy Wheel	*1,500*	*5,000*
Line	*10,000*	*35,000*
Total demand	*25,000*	*95,000*
Out of which systems purchases	*18,000*	*60,000*

The minimum production capacity of dot matrix and daisy wheel printers is expected to be 10,000 printers per annum, the former capturing 65 per cent of the output. The import of needed technology will be linked with indigenisation. The required plant and equipment will comprise standard machines for PCB assembly and other testing and measuring instruments. An initial project cost of Rs 40 million is considered sufficient. The payback period is expected to be four to five years.

A concessional duty of 25 per cent on import of capital goods is applicable to the computer peripherals industry. While major components such as PCBs are charged a customs duty of 50 per cent, other parts are charged a nominal duty of five per cent.

CAL Systems bags order for 20 bilingual computers

CAL Systems Private Limited has bagged the tender for 20 'Sulekh' bilingual computer systems and wordprocessors from CPWD—a highly competitive tender in which some well known Indian companies had participated. These systems have to be supplied to various offices of CPWD all over the country.

CPWD is the first government department to have taken a serious effort of following the central government's guidelines of purchasing computer system only with the bilingual capabilities. The configuration specified by them meets the requirements of their various offices for varied applications and at the same time providing bilingual capabilities.

CAL Systems had a distinct advantage over other companies, having already installed a large number of computer systems in various central/state government departments, public sector undertakings, defence etc. This is the only system in the country which can be upgraded to handle data processing in Hindi and English or any other two languages.

This bilingual computer system is 100 per cent compatible to IBM PC software. It gives a distinct advantage of using standard utilities for wordprocessing, DBMS, spreadsheet etc.

ONGC to acquire IBM computer

The Oil and Natural Gas Commission [ONGC] has decided to acquire a large IBM computer system with a capacity of processing around 40,000 standard records per day. The commission has applied for an import licence after getting the go ahead from the US.

The proposed large capacity system IBM 3083 J×3 has a central memory of 32MB with 24 channels. The total disc capacity is around 25GB.

Currently, ONGC has the capacity to process 1.5 million standard records per year. With the installation of the IBM computer system, this facility will increase to 10 million standard records per year. As per its accelerated production plan, ONGC's requirement is expected to go up to 26 million standard records by 1990. The total cost of the IBM computer is estimated at Rs 463.4 million.

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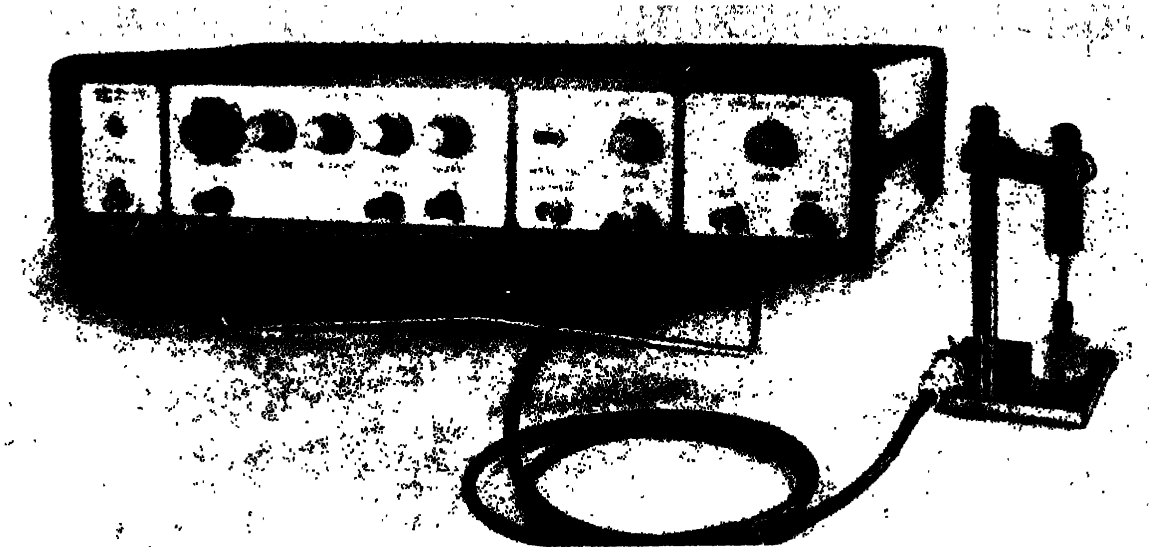

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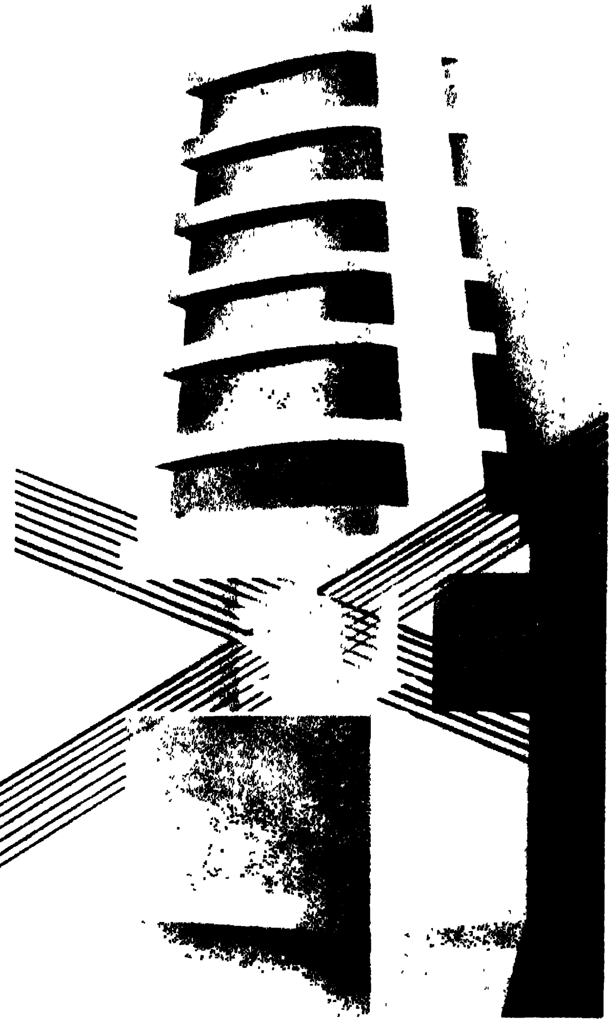

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kW	20	20	50	50	100	20

	ILU-7	ILU-8
MeV	2.0-3.0	0.5-0.8
kW	50	20

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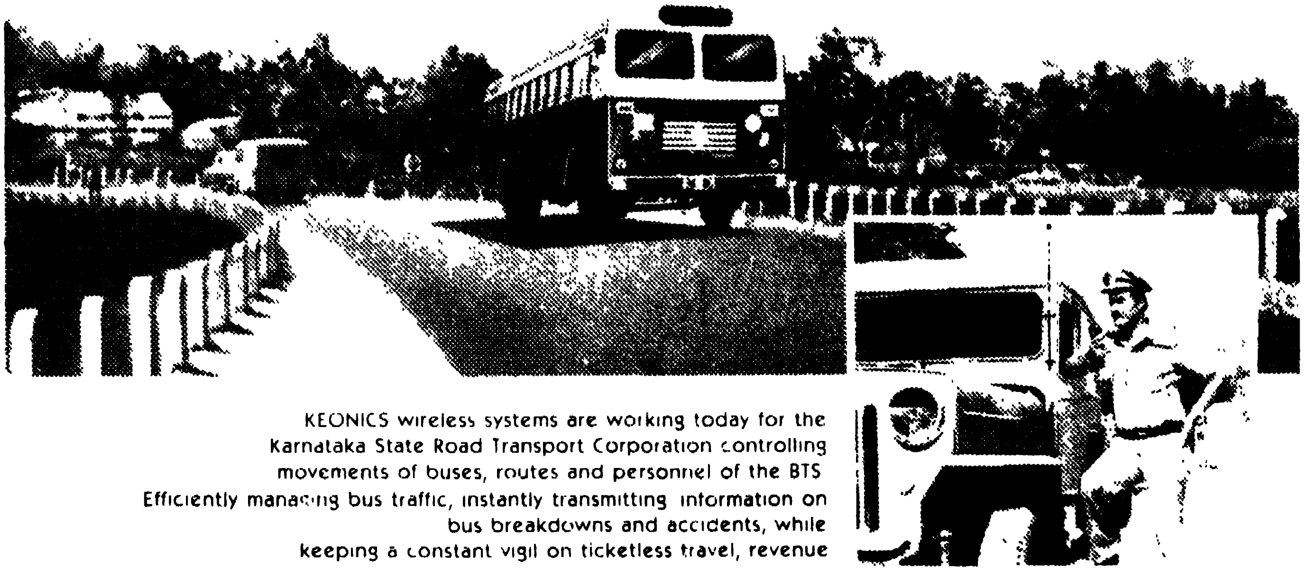

KEONICS wireless systems are working today for the Karnataka State Road Transport Corporation controlling movements of buses, routes and personnel of the BTS Efficiently managing bus traffic, instantly transmitting information on bus breakdowns and accidents, while keeping a constant vigil on ticketless travel, revenue collection and staff movements.

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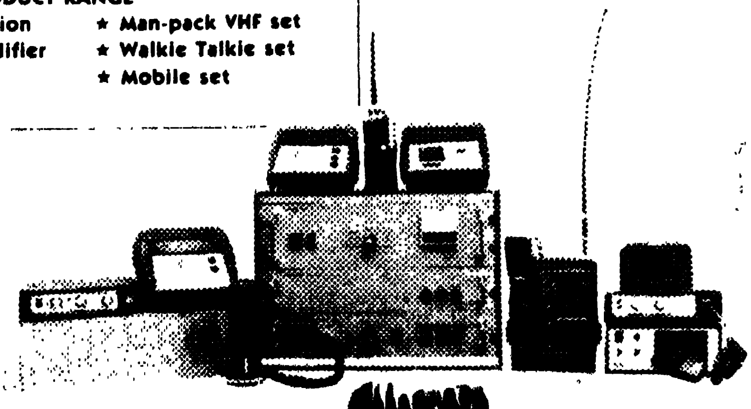

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Learning the Morse Code With Sinclair Computer

Ashok Baijal, VU2AEY

If you are interested in taking the Amateur Station Operators' Licence examination conducted by the central government's, Ministry of Communications, then it is essential to know the International Morse Code.

For the Amateur Station Operators' Grade II examination, a test piece consists of a plain language passage of 125 letters five letters counting as one word. The candidate is required to receive the passage for five consecutive minutes at the speed of five words per minute. More than five errors disqualify a candidate. However, if a candidate receives the test piece correctly for a continuous period of one minute during the transmission, he is considered successful in the test.

For the Amateur Station Operators' Grade I examination, the test piece consists of a plain language passage of 300 characters which may comprise letters, figures and punctuation marks such as full stop, comma, semicolon, break sign and question mark. The average word has five characters and each figure and punctuation is counted as two characters.

Candidates are required to receive for five consecutive minutes at a speed of 12 words per minute. However, if the candidate receives the test piece correctly for a continuous period of one minute, he is considered successful in the examination.

All letters, numerals and punctuation marks are made of three basic elements the dot, the dash and the space. A dot is the basic unit. The duration of a dash is three times that of the dot. The space between each element is that of one dot. The space between two letters is three dots and the interspacing between words is equal to five dots.

A word of caution to the beginner. The characters should be identified by the sounds rather than their graphic equivalents (shapes). Before one starts practising morse code, one should have had enough practice in receiving it.

The International Morse Code

A di dah	. —
B dah di di dit	— . . .
C dah di dah dit	— — .
D dah di dit	— . .
E dit	.
F di di dah dit	. . — .
G dah dah dit	— — .
H di di di dit	. . . .
I di dit	. .
J di dah dah dah	. — — —
K dah di dah	— . —
L di dah di dit	. — . .
M dah dah	— —
N dah dit	— .
O dah dah dah	— — —
P di dah dah dit	. — — .
Q dah dah di dah	— — . —
R di dah dit	. — .
S di di dit	. . .
T dah	—
U di di dah	. . —
V di di di dah	. . . —
W di dah dah	. — —
X dah di di dah	— . . —
Y dah di dah dah	— . — —
Z dah dah di dit	— — . .
1 di dah dah dah dah	. — — — —
2 di di dah dah dah	. . — — —
3 di di di dah dah	. . . — —
4 di di di di dah	. . . . —
5 di di di di dit	. . . . .
6 dah di di di dit	— . . . .
7 dah dah di di dit	— — . . .
8 dah dah dah di dit	— — — . .
9 dah dah dah dah dit	— — — — .
0 dah dah dah dah dah	— — — — —
Period (full stop): di dah di dah di dah	. — . — . —
Comma: dah dah di di dah dah	— — . . — —
Question Mark: di di dah dah di dit	. . — — . .
Error: di di di di di di di dit	. . . .
Double Dash: dah di di di dah	— . . . —
Colon: dah dah dah di di dit	- - — — . . .
Semicolon: dah di dah di dah dit	— . — . — .

Given below is a program written for the Sinclair Spectrum which will assist in mastering the morse code.

Program Listing

```
10 DIM A$(26,4)
20 DATA ".-", "-...", "-.-.", "-..", ".", "..-.", "--.", "....", "..",
   ".---", "-.-", ".-..", "--", "-.", "---", ".--.", "--.-", ".-
   .", "...", "-", "..-", "...-", ".--", "-..-", "-.--", "--.."
30 FOR I = 1 TO 26
40 READ A$(I)
50 NEXT I
60 DIM B$(10,5)
70 DATA "-----", ".----", "..---", "...--", "....-", ".....",
   "-....", "--...", "---..", "----.",
80 FOR J = 1 TO 10
90 READ B$(J)
100 NEXT J
110 DIM C$(6,7)
120 DATA ".-.-.-", "--..--", "-.-.-.", "---...", "-....-", "..--..",
130 FOR K = 1 TO 6
140 READ C$(K)
150 NEXT K
160 DIM D$(6)
170 DATA ".", ",", ";", ":", "-", "?"
180 FOR L = 1 TO 6
190 READ D$(L)
200 NEXT L
210 PRINT AT 15,1; "Input speed at which you would like to practice"
220 INPUT M : CLS
230 LET N = 1/M
240 PRINT AT 10,1;"For Letters type 1"
241 PRINT AT 12,1;"For Numbers type 2"
242 PRINT AT 14,1;"For Punctuation type 3"
243 PRINT AT 16,1;"For Mixed type 0"
250 INPUT Z
260 FOR P=6 TO 1 STEP-1
270 PAPER P: BORDER P: CLS
280 PAPER 7
300 FOR Q = 1 TO 21
310 DIM E$(5)
320 DIM F$(5,6)
330 FOR R = 1 TO 5
335 LET X = Z
340 IF Z=0 THEN LET X=1+INT(RND*6)
350 IF X>3 THEN LET X=1
360 GOSUB X*1000
370 PRINT AT Q,0 ; " "; E$(R); " "; F$(R)
380 FOR W = 1 TO 6
390 IF F$(R,W) = "." THEN BEEP N,3: PAUSE INT(50*N)
400 IF F$(R,W) = "-" THEN BEEP 3N,3: PAUSE INT(50*N)
410 NEXT W
420 PAUSE INT(100*N)
430 NEXT R
440 IF Q/2 = INT(Q/2) THEN PRINT AT Q,16; " ";E$; " "; GOTO 460
450 PRINT AT Q,24; " "; E$; " "
460 PAUSE INT(100*N): NEXT Q
470 PAUSE 40000
480 NEXT P
490 GOTO 210
1000 LET T = 1+INT(RND*26)
1010 LET E$(R) = CHR$(64+T)
1020 LET F$(R) = A$(T)
1030 RETURN
2000 LET U = 1+INT(RND*10)
2010 LET E$(R) = CHR$(47+U)
2020 LET F$(R) = B$(U)
2030 RETURN
3000 LET V = 1+INT(RND*6)
3010 LET E$(R) = D$(V)
3020 LET F$(R) = C$(V)
3030 RETURN
```

Lines 10-50: Lines 10 to 50 store the morse equivalents of letters in the computer's memory.

Lines 60-100: These instructions store the morse equivalent of numerals in the memory.

Lines 110-200: These instructions transfer the morse equivalents of punctuation marks in the memory.

Lines 210-230: These instructions set the speed at which the morse practice is given by the computer. The program on being run displays a menu and requests the operator to input the speed. The operator must then enter the desired speed.

Lines 240-250: These lines display another menu. Four options are given to the operator. He can choose between Letters only/ Numbers only/ Punctuation Marks only or get a mixture of all the three. The operator can make his choice by entering 1, 2, 3, or 0.

Lines 260-280: These instructions set the colour of the television screen. After each set of 22 groups the colour of the screen changes.

Lines 340-350: These instructions generate a random pattern of letters, numerals and punctuation marks, when the choice is for a mixed type of passage.

Line 360: This line directs the computer to go to line 1000 if the character is a letter, to line 2000 if the character is a numeral or to line 3000 if it is a punctuation mark.

Line 370: This line prints out the character and its morse equivalent, on the left half of the screen, which the computer is sending. This will be of great help to the beginner.

Lines 390-400: These lines produce the dot and dash sounds. The internal speaker of the computer is good for a quiet room. An amplifier can be attached to the mic. output of the computer for a louder sound.

Lines 440-450: Lines 440 and 450 print the group of five characters on the right half of the screen after the group has been sent. This will help in comparing your notes.

Lines 470-480: Line 470 halts the computer after a set of 22 characters has been sent. Press any key on the keyboard to continue.

Lines 1000-1030: This subroutine generates random letters. Line 1010 generates the letter and line 1020 generates its morse equivalent.

Lines 2000-2030: This subroutine generates numerals.

Lines 3000-3030: This subroutine generates punctuation marks. ☐

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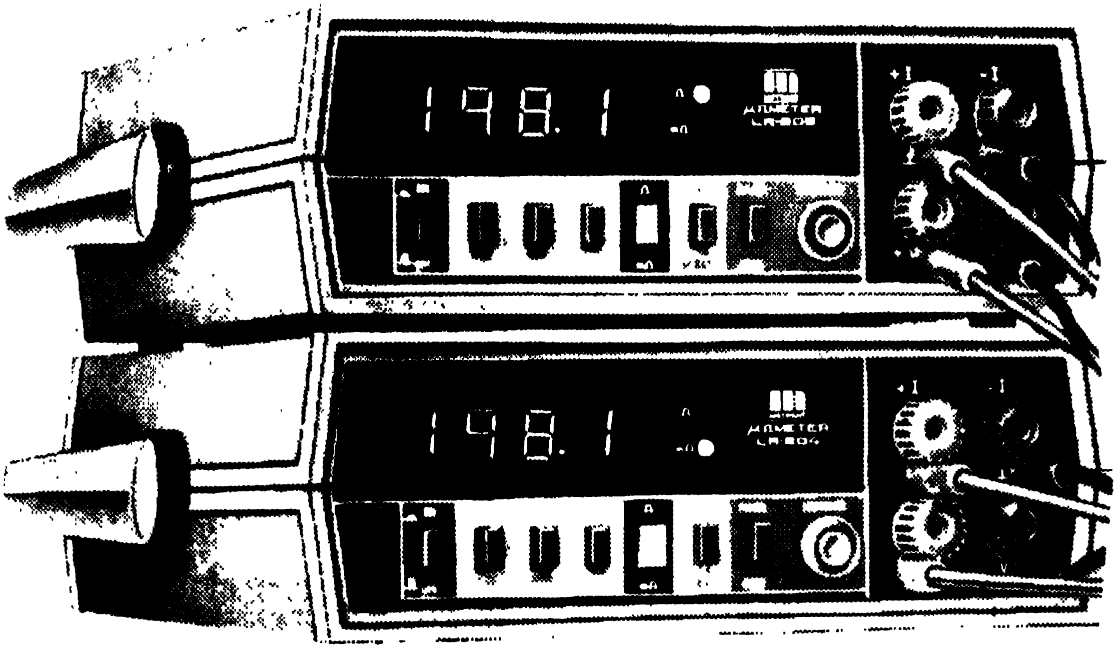

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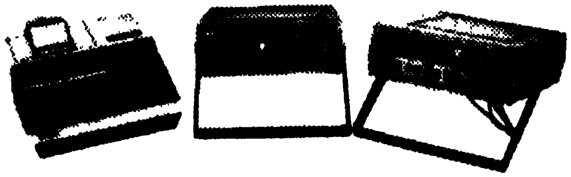

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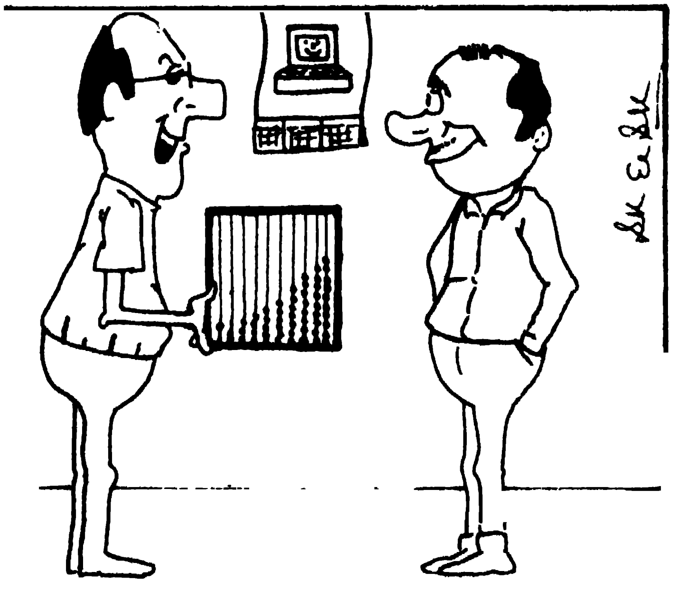
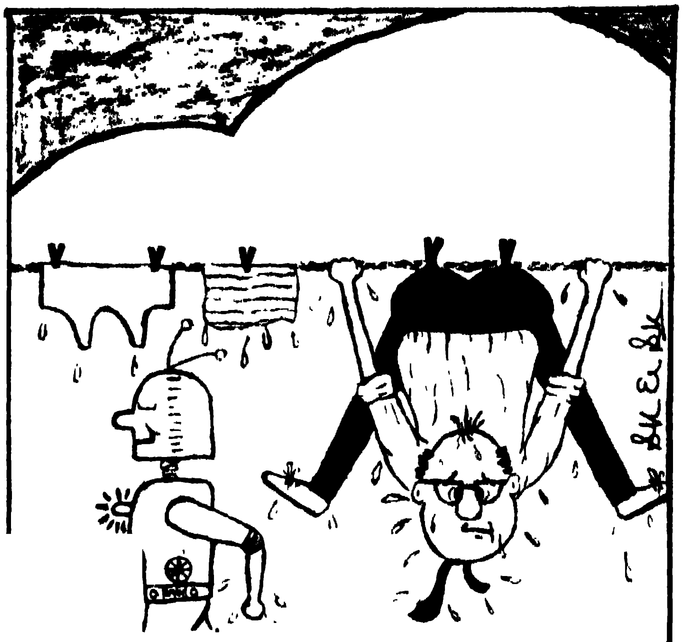
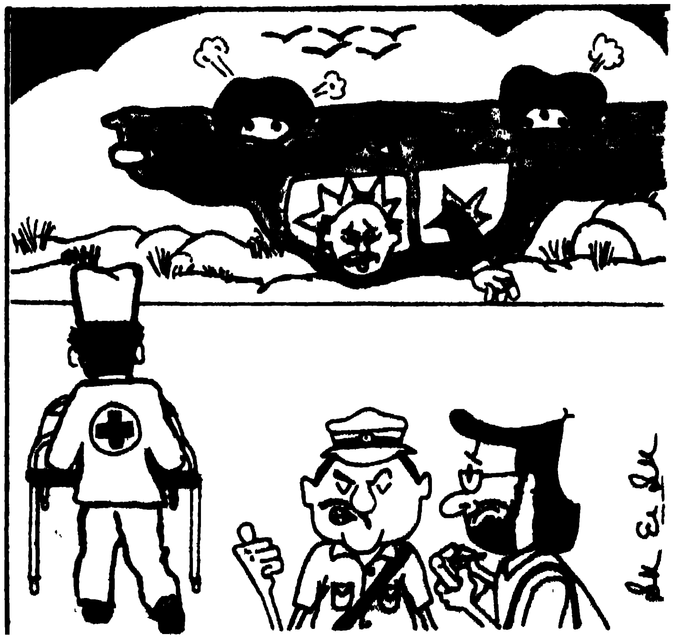


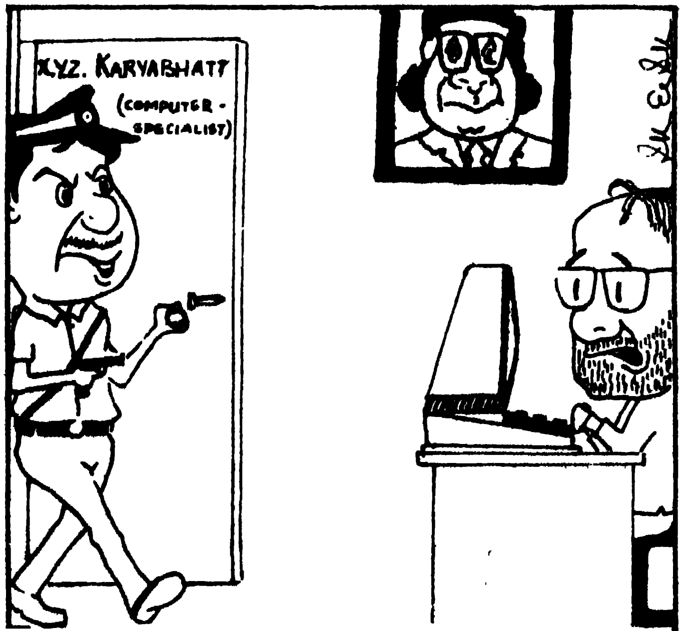
"My son has been demanding a personal computer. I'm giving him this to make a beginning till I can collect enough money for his PC."



"Oh Yes! I developed him to wash my clothings. But, you see, clothes are a bit scarce with me."



"The crazy chap installed a video car-racing game in his car! While driving, he skilfully saved his 'car' on the video-screen from crashing, but, unfortunately.........."



"I've come to arrest your computer! It seems to have 'stolen' some information from our data bank last night."

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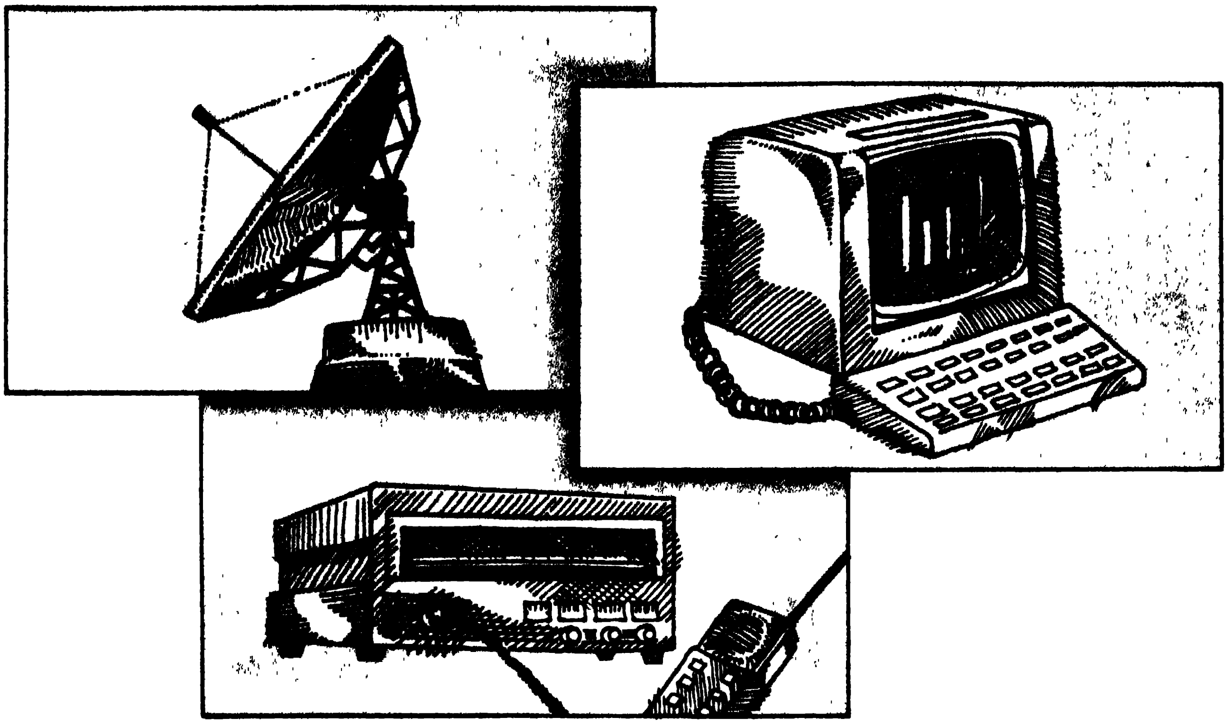

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SE-8501

An Introduction to Compilers

Part II

Suresh K. Basandra

It is worth noting that programming languages with the structure of ('standard') ALGOL, where each program is a single procedure, do not lend themselves to one-pass compiling, since forward jumps, for example, may traverse the entire length of the program. In contrast, languages like PL/I or FORTRAN lend themselves to a programming style in which large programs can be created as a sequence of relatively small procedures or subroutines. In these cases, most backpatching can be done on a procedure together (thus providing a hidden extra pass not thought of as part of the compiler). In fact, for this reason, among others, most ALGOL implementations add to the 'standard' by allowing programs to consist of a sequence of procedures which may be linked.

In this article, it is not intended to consider how much processing should be done in one pass or how big a given pass should be. The answer to this question is dependent on the particular environment of a given compiler. Rather, it is intended to study each phase of the compilation process shown in Fig. 3 (Part I of the article) as a process in itself, investigating algorithms and tradeoffs that are applicable to the phase alone. It should be kept in mind, however, that in any real compiler, all phases must act in concert, and that a strategy adopted for one phase can affect the type of processing that must be done in a subsequent phase.

Lexical analysis

The performance of lexical analysis on source program text is perhaps the most well understood and easiest part of the compilation process. As a large part of the total compilation time is spent in performing lexical analysis, an attempt must be made to simplify it as far as possible.

The lexical analyser is the interface between the source program and the compiler. The lexical analyser reads the source program one character at a time, carving the source program into a sequence of atomic units called 'tokens'. Each token represents a sequence of characters that can be treated as a single logical entity. Identifiers, keywords, constants, operators, and punctuation symbols such as commas and parentheses are typical tokens. For example, in the FORTRAN statement

IF (5. EQ. MAX) GO TO 100 (1)

we find the following eight tokens: IF; (;5;.EQ.;MAX;); GOTO; 100.

What is called a token depends on the language at hand and, to some extent, on the discretion of the compiler designer. But in general each token is a substring of the source program that is to be treated as a single unit. For example, it is not reasonable to treat M or MA (of the identifier MAX above) as an independent entity.

There are two kinds of tokens: specific strings such as IF or a semicolon; and classes of strings such as identifiers, constants, or labels. To handle both cases we shall treat a token as a pair consisting of two parts: a token type and a token value.

For convenience, a token consisting of a specific string such as a semicolon will be treated as having a type (the string itself) but no value. A token such as the identifier MAX above has a type 'identifier' and a value consisting of the string MAX. Frequently, we shall refer to the type or value as the token itself. Thus, when we talk about identifier being a token, we are referring to a token type. And when we talk about MAX being a token, we are referring to a token whose value is MAX.

The lexical analyser and the following phase, the syntax analyser, are often grouped together into the same pass. In that pass, the lexical analyser operates either under the control of the parser or, as a coroutine with the parser. The parser asks the lexical analyser for the next token, whenever the parser needs one. The lexical analyser returns to the parser a code for the token that it finds. In the case that the token is an identifier or another token with a value, the value is also passed to the parser.

The usual method of providing this information is for the lexical analyser to call a book-keeping routine which installs the actual value in the symbol table if it is not already there. The lexical analyser then passes the two components of the token to the parser. The first is a code for the token type (identifier), and the second is the value—a pointer to the place in the symbol table reserved for the specific value found.

Finding tokens

To find the next token, the lexical analyser examines successive characters in the source program, starting from the first character not yet grouped into a token. The lexical analyser may be required to search many characters beyond the next token in order to determine what the next token actually is.

Syntax analysis

We now turn to the most important part of the analysis phase. The problem on hand is, given a sequence of symbols, to find the syntactic structure that binds all of them to form the source program. When this structure is discovered, we can consider the problem of semantic transformation of the source program into an internal form.

The first thing to be done is to find a 'derivation' for the given sentence. An equivalent task is the construction of the unique 'syntax tree' for the sentence. Another synonymous term for this work is 'parsing'. This is the job for the syntax analyser.

A natural way of processing the input sequence of symbols is from left-to-right. The only question which remains open is whether the parsing should be from the symbols in the sentence to the distinguished symbol, i.e. bottom-up or whether it should be from the distinguished symbol to the sentence.

Both methods are used in syntax analysis. Each of the methods is named accordingly: the one which constructs syntax trees upwards from the input symbols to the distinguished symbol is called 'bottom-up' parsing, and the one which constructs syntax trees downwards from the distinguished symbol to the symbols in the sentence is called 'top-down' parsing.

Top-down approaches to problem-solving and, especially, top-down presentations of solutions to problems are much easier to understand. Hence top-down parsing strategies will only be considered.

The parser has two functions: First, it checks that the token appearing in its input, which is the output of the lexical analyser, occurs in patterns that are permitted by the specification for the source language. Secondly, it imposes on the token a tree-like structure that is used by the subsequent phases of the compiler.

For example, if a PL/1 program contains the expression

A + / B

then after lexical analysis this expression might appear to the syntax analyser as the token sequence

id + / id

On seeing the /, the syntax analyser should detect an error situation, because the presence of these two adjacent binary operators violates the formulation rules of a PL/1 expression.

The second aspect of syntax analysis is to make explicit the hierarchical structure of the incoming token stream by identifying which parts of the token stream should be grouped together. For example, the expression

A / B * C

has two possible interpretations:

(a) divide A by B and then multiply by C (as in FORTRAN); or

(b) multiply B by C and then use the result to divide A (as in APL).

Each of these two interpretations can be represented in terms of parse tree, a diagram which exhibits the syntactic structure of the expression. Parse trees that reflect orders (a) and (b) are shown in Figs 4(a) and 4(b), respectively. Note how in each case the operands of the first operation to be performed meet each other at a lower level than that at which they meet the remaining operand.

The language specification must tell us which of the interpretations (a) and (b) is to be used and, in general, what hierarchical structure each source program has. These rules form the syntactic specification of a programming language. It can be mentioned that context-free grammars are particularly helpful in specifying the syntactic structure of a language. Moreover, efficient syntactic analysers can be constructed automatically from certain types of context-free grammars.

Intermediate code generation

On a logical level the output of the syntax analyser is some representation of a parse tree. The intermediate code generation phase transforms this parse tree into an intermediate-language representation of the source program.

Three-address code

One popular type of intermediate language is what is called 'three-address code'. A typical three-address code statement is

A : = B op C

where A, B and C are operands and op is a binary operator.

The parse tree in Fig. 4(a) might be converted into the three-address code sequence:

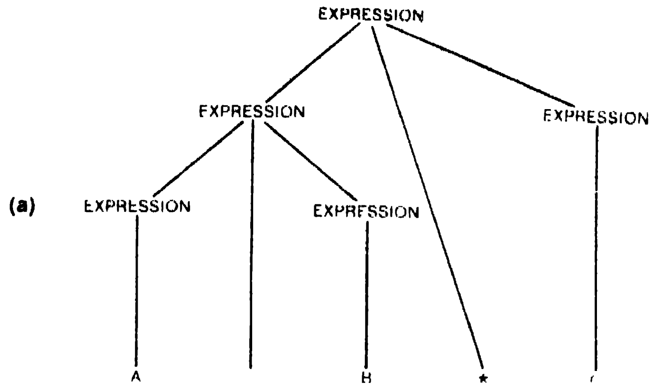

Fig. 4(a): A parse tree.

```
T1: = A / B
T2: = T1 * C
```

where T1 and T2 are names of temporary variables.

In addition to statements that use arithmetic operators, an intermediate language needs unconditional and simple conditional branching statements, in which at most one relation is tested to determine whether or not a branch is to be made. Higher-level flow of control statements such as while-do statements, or if-then-else statements are translated into these lower-level conditional three-address statements.

Optimisation

Object programs that are frequently executed should be fast and small. Certain compilers have within them a phase that tries to apply transformations to the output of the intermediate code generator, in an attempt to produce an intermediate-language version of the source program from which a faster or smaller object-language program can ultimately be produced. This phase is popularly called the 'optimisation phase'.

The term 'optimisation' in this context is a complete misnomer, since there is no algorithmic way of producing a target language program that is the best possible under any reasonable definition of 'best'. Optimising compilers merely attempt to produce a better target program than would be produced with no optimisation. A good optimising compiler can improve the target program by perhaps a factor of two in overall speed, in comparison with a compiler that generates code carefully but without using the specialised techniques generally referred to as code optimisation.

Local optimisation

There are 'local' transformations that can be applied to a program to attempt an improvement. For example, we can have instances of jumps over jumps in the intermediate code, such as

```
    if A > B   goto   L2
    goto   L3
L2:                                   (2)
```

This sequence could be replaced by the single statement

```
    if A < B   goto   L3              (3)
```

Sequence (2) would typically be replaced in the object program by machine statements which:

(a) compare A and B to set the condition codes,
(b) jump to L2 if the code for > is set, and
(c) jump to L3.

Sequence (3), on the other hand, would be translated to machine instructions which:

(d) compare A and B to set the condition codes, and
(e) jump to L3 if the code for or = is set.

If we assume A B is true half the time, then for (2) we execute (a) and (b) all the time and (c) half the time, for an average of 2.5 instructions. For (3) we always execute two instructions, a 20% savings. Also (3) provides a 33% space saving if we crudely assume that all instructions require the same space.

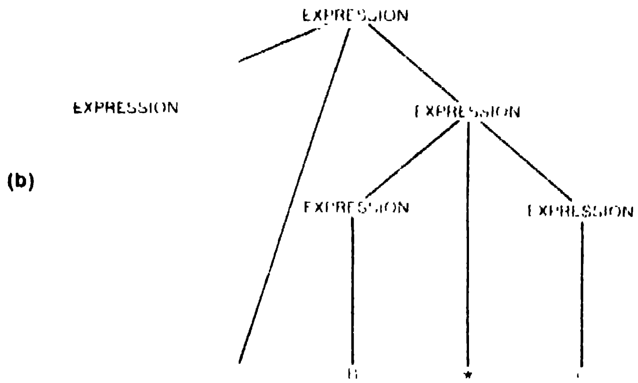

Fig. 4(b): Another parse tree.

Another important local optimisation is the elimination of common sub-expressions. Provided A is not an alias for B or C, the assignment

```
A : = B + C + D
E : = B + C + F
```

might be evaluated as

```
T1 : = B + C
A : = T1 + D
E : = T1 + F
```

taking advantage of the common sub-expression B+C. Common sub-expressions written explicitly by the programmer are relatively rare, however. A more productive source of common sub-expressions arises from computations generated by the compiler itself. Chief among these is subscript calculation. For example, the assignment

```
A [I] : = B [I] + C [I]
```

will, if the machine memory is addressed by bytes and there are, say, four bytes per word, require (4 * I) to be computed three times.

An optimising compiler can modify the intermediate program so that the calculation of (4 * I) is done only once. Note that it is impossible for the programmer to specify that this calculation of (4 * I) be done only once in the source program, since these address calculations are not explicit at the source level.

Loop optimisation

Another important source of optimisation concerns speed-ups of loops. Loops are especially good targets for optimisation because programs spend most of their time in inner loops. A typical loop improvement is to move a computation that provides the same result each time around the loop to a point in the program just before the loop is entered, rather than once for each interaction of the loop. Such a computation is called 'loop invariant'.

Various kinds of optimisation can be performed, and a list of a few of them is given below. Optimisation resulting in reduced execution time for the resultant program are:

(a) compile-time evaluation of expressions involving only constant operands; this optimising transformation is called 'folding';

(b) eliminating common sub-expressions,

(c) Boolean expression optimisation;

(d) moving invariant computations outside loops (from within);

(e) strength reduction of operators within loops;

(f) initialising values of variables at compile time;

(g) replacing a call to a produce by its body; and

(h) unrolling a loop; etc.

While all the above optimisations save execution time, it is worth noting that (a), (b) and (f) also save space, viz, they result in shorter programs. Optimisations (c), (d) and (e) result in faster programs by either not computing unrequired or unchanging values repeatedly, or by using simpler and hence faster operations. However, they do not contribute to any saving in space at all. Optimisations (g) and (h), result in faster programs but, clearly, at the expense of using more space to store longer programs.

Optimisation aimed at primarily reducing the amount of storage used are not many. Usually, they involve the problem of reducing the use of temporary storage in some form or the other, e.g. rearranging the operations in an arithmetic-expression to minimise the number of temporary locations used.

Code generation

Code generation is one of the least formalised subjects in compiler construction. While some cohesion seems evident in the trends in the evolution of higher-level programming languages, the same cannot be said of machine architecture. As a result, each machine seems to require a separate and exhaustive case analysis before code generation can be attempted for it.

The task set for the code generation phase of a compiler is, normally, to take as input a given internal form representation of the source program and to produce as output an equivalent sequence of instructions in the language of the object machine. In the case of one-pass load-and-go compiler, the luxury of an internal form representation of source programs cannot be afforded. The code generation phase of such compilers is therefore more complex compared to those of multi-pass compilers and they interface directly with the source program semantic-analysis actions.

It is undoubtedly appreciated that there is a great gap in the levels of detail of specification of the same algorithm in source and object languages. Object languages make explicit mention of locations used for temporary storage of values whereas corresponding names do not exist in the source language. A programmer programming in an object language is expected to be aware of internal registers of the machine, their function and the saving in time obtained from their use. Once again, the notion of such 'word area' is nearly non-existent as far as programming in a source language is concerned.

It is not intended to exhaustively list the differences between source and object languages. The point made here is that a burden of the code generator of a compiler is to make a note of those resources in the object language that are not visible in the source language. Next, the code generator should preserve and update a model of these resources and their status as it produces code (instructions in the object language that make use of these (and other) resources of the object machine). The object of this exercise is to make an efficient use of the resources of the object machine.

The code generation phase converts the intermediate code into a sequence of machine instructions. A simple-minded code generator might map the statement

```
A : = B + C
```

into the machine code sequence

```
LOAD B
ADD C
STORE A
```

However, such a straightforward macro-like expansion of intermediate code into machine code usually produces a target program that contains many redundant loads and stores, and thus utilises the resources of the target machine inefficiently. To avoid these redundant loads and stores, a code generator might keep track of the run-time contents of registers. Knowing what quantities reside in registers, the code generator can generate loads and stores only when necessary.

Many computers have only a few high-speed registers in which computations can be performed particularly quickly. A good code generator would, therefore, attempt to utilise these registers as efficiently as possible. This aspect of code generation, called 'register allocation', is particularly difficult to do optimally, but some heuristic approaches can give reasonably good results.

Book-keeping

A compiler needs to collect information about all the data objects that appear in the source program. For example, a compiler needs to know whether a variable represents an integer or a real number, what size an array has, how many arguments a function expects, and so forth.

The information about data objects may be explicit, as in declarations, or implicit, as in the first letter of an identifier or in the context in which an identifier is used. For example, in FORTRAN, A(I) is a function call if A has not been declared to be an array.

The information about data objects is collected by the early phases of the compiler lexical and syntactic analysis and entered into the symbol table. For example, when a lexical analyser sees an identifier, MAX, say, it may enter the name MAX into the symbol table if it is not already there, and produce as output a token whose value component is an index to this entry of the symbol table. If the syntax analyser recognises a declaration 'integer' MAX, the action of the syntax analyser will be to note in the symbol table that MAX has type 'integer'. No intermediate code is generated for this statement.

The information collected about the data objects has a number of uses. For example, if we have the expression A + B, where A is of type integer and B of type real, and if the language permits an integer to be added to a real, then on most computers code must be generated to convert A from type integer to type real before the addition can take place. The addition must be done in floating point, and the result is real. If mixed-mode expressions of this nature are forbidden by the language, then the compiler must issue an error message when it attempts to generate code for this construct.

The term 'semantic analysis' is applied to the determination of the type of intermediate results, the check that arguments are of types that are legal for an application of an operator, and the determination of the operation denoted by the operator. (For example, '+' could denote fixed or floating add, perhaps logical 'or' and possibly other operations as well.) Semantic analysis can be done during the syntax analysis phase, the intermediate code generation phase, or the final code generation phase.

Error handling

One of the most important functions of a computer is the detection and reporting of errors in the source program. The error messages should allow the programmer to determine exactly where the errors have occurred. Errors can be encountered by virtually all the phases of a compiler. For example,

1. The lexical analyser may be unable to proceed because the next token in the source program is mis-spelled.
2. The syntax analyser may be unable to infer a structure for its input because a syntactic error such as a missing parenthesis has occurred.
3. The intermediate code generator may detect an operator whose operands have incompatible types.
4. The code optimiser, doing control flow analysis, may detect that certain statements can never be reached.
5. The code generator may find a compiler-created constant that is too large to fit in a word of the target machine.
6. While entering information into the symbol table, the book-keeping routine may discover an identifier that has been multiply declared with contradictory attributes.

Whenever a phase of the compiler discovers an error, it must report the error to the error handler, which issues an appropriate diagnostic message. Once the error has been noted, the compiler must modify the input to the phase detecting the error, so that the latter can continue processing its input, looking for subsequent errors.

Good error handling is difficult because certain errors can mask subsequent errors. Other errors, if not properly handled, can spawn an avalanche of spurious errors.

Factors affecting compiler design and implementation

Several aspects have to be considered in the implementation of a programming language. Amongst them, the chief ones are syntax, semantics and pragmatic issues (like the relationship between the language and the users). For instance, whether symbol tables should be printed out and how errors in programs are to be reported are pragmatic issues which in no way affect the correctness of a compiler.

Additionally, there are questions, such as, should the compiler be very fast and not bother too much about the kind of code it generates, or should it take its time in producing the object program taking care that the result is an optimised object program with substantially reduced storage and run-time requirements? All such factors play an important part in the design of a compiler.

Other major factors affecting the implementation strategy are the language in which the compiler is written, the structure of the group that writes it and the resources available, i.e. the size of the implementation machine, the time for the completion of the project, etc.

Compiler-writing tools

A number of tools have been developed to help construct compilers. These tools range from scanner and parser generators to complex systems, variously called 'compiler-compilers' 'compiler-generators' or 'translator-writing systems' which produce a compiler from some form of specification of a source language and target machine.

The input specification for these systems may contain:

(a) a description of the lexical and syntactic structure of the source language;

(b) a description of what output is to be generated for each source language construct; and

(c) a description of the target machine.

In many cases the specification is merely a collection of programs fitted together into a framework by the compiler-compiler. Some compiler-compilers, however, permit a portion of the specification of a language to be non-procedural rather than procedural. For example, instead of writing a program to perform syntax analysis, the user writes a context-free grammar and the compiler-compiler automatically converts that grammar into a program for syntax analysis.

While a number of useful compiler-compilers exist, they have limitations. The chief problem is that there is a trade-off between how much work the compiler-compiler can do automatically for its user and how flexible the system can be.

For example, it is tempting to assume that lexical analysers for all languages are really the same, except for the particular keywords and signs recognised. Many compiler-compilers do in fact produce fixed lexical analysis routines for use in the generated compiler. These routines differ only in the list of keywords recognised, and this list is supplied by the user. This approach is quite valid, but may be unworkable if it is required to recognise non-standard tokens such as identifiers that may include characters other than letters and digits

More general approaches to the automatic generation of lexical analysers exist but these require the user to supply more input to the compiler-compiler, i.e. to do more work.

The principal aids provided by existing compiler-compilers are:

1. **Scanner generators.** The 'built-in' approach described above and regular expression based techniques are the most common approaches.

2. **Parser generators.** Almost every compiler-compiler provides one. The reason is twofold. First, while parsing represents only a small part of compiler construction, with a fixed framework in which parsing is done can be a great aid in the organisation of the entire compiler. Secondly, the parsing phase is unique among the compiler phases in that a notation known as the context-free grammar exists which is sufficiently non-procedural to reduce the work of the compiler writer significantly, sufficiently general to be of use in any compiler, and sufficiently developed to permit efficient implementations to be generated automatically. One significant advantage of using a parser generator is increased reliability. A mechanically generated parser is more likely to be correct than one produced by hand.

3. **Facilities for code generation.** Often a high-level language especially suitable for specifying the generation of intermediate, assembly or object code is provided by the compiler-compiler. The user writes routines in this language and, in the resulting compiler, the routines are called at the correct times by the automatically generated parser. A common feature of compiler-compilers is a mechanism for specifying decision tables that select the object code. These tables become part of the generated compiler, along with an interpreter for these tables supplied by the compiler-compiler.

A compiler is characterised by three languages: its source language, its object language, and the language in which it is written. These languages may be quite different. For example, a compiler may run on one machine and produce object code for another machine. Such a compiler is often called a 'cross-compiler'. Many minicomputer and microprocessor compilers are implemented this way; they run on a bigger machine and produce object code for the smaller machine. □

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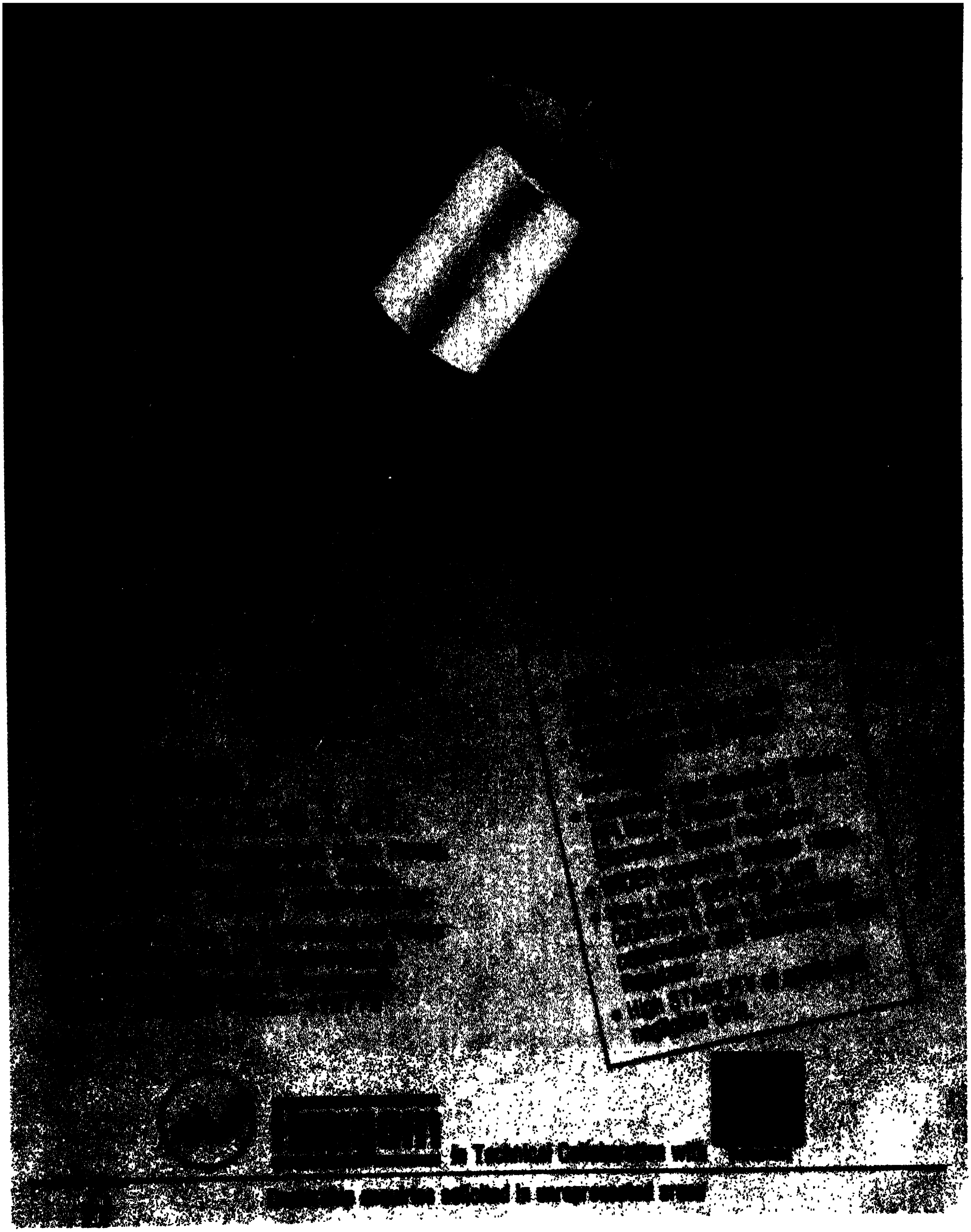


Comparative Study of Computer Languages

Program Organisation (1)

Part XIV

R. Ramaswamy

A program is a set of instructions written in a computer language, for solving a problem. Each instruction is called a statement in the computer language. Statements in a computer language are analogous to sentences in a spoken language. Just as a sentence gives complete meaning to the humans, a statement gives complete meaning to the computer. Just as a story consists of a set of logically organised sentences, a program consists of a set of logically organised statements.

Minimum statements required to program simple problems

What are simple problems? By simple problems we mean problems whose solutions can be obtained by means of a single formula. We have already pointed out that a problem may have either a single formula or a set of formulae. When the problem solution requires the computation of more than one formula, the logic is said to be complex, otherwise the logic is simple or straightforward

A program must read the data and the processing steps. It must print the result on paper. We need statements to do the above functions. First, we need an input statement to read the data. Next, a computation statement to compute the result. Lastly, an output statement for printing the result on paper. Some comment statements inside the program will be useful to the readers to know what the program is about and what it is doing at every stage. Just as a story is organised by logically sequencing the sentences, a program is organised by logically sequencing the different statements. The minimum statements for writing a program are:

1. Input statement
2. Computation statement
3. Output statement
4. Comment statement

We have already seen how the first three types of statements can be written in the different languages. Now we can see how a simple program can be organised in each of the languages. The comment statements will be explained as we describe the program organisation.

FORTRAN program organisation

A program consists of a set of statements, written on a line by line basis. Each line is 80 characters long. In FORTRAN only one statement can be written in a line. There are some restrictions as to the columns in which the statements must be written. Statements can be written only from columns seven to 72. We have said that statements are referenced by giving labels or names in the form of integer numbers.

The statement numbers are written in columns two to five. If the statement is longer than one line, it can be continued in the next line. To tell the computer that a line contains the continuation of the statement from the previous line, a character, say, 1 (or any other character) is keyed in column six. So, the column six is called the continuation mark column. The statement can be continued in the third, fourth, fifth line and so on, every time keying a different character in the sixth column. The computer senses the end of a statement by the absence of any continuation mark in the sixth column of the next line.

Columns 73 to 80 are left blank. The first column is reserved to give indication to the computer that the remaining information keyed in that line are comments intended for the readers and not intended for processing purposes. This indication is given to the computer by keying the letter C in the first column. So, the first column is called the comment column. Due to the restrictions in the columns in which the different items have to be keyed, we say that a FORTRAN program is highly column oriented.

Program files

A program must be stored in a machine decipherable media before it can be used for processing data. In the microcomputer environment, floppy diskettes are used for storing programs as well as data. Just as the humans use paper for storing information, the computer uses the floppy diskettes for storage purposes. The storage media is called the auxiliary memory. It is also called the computer file or, simply, file. When we write the program in the floppy diskette, we say that we store the program as program file. One can ask why not store the program in paper media itself, just as humans do.

Unfortunately, machines cannot decipher what is written on paper. (Hopefully such machines will come to popular use very soon.) Humans cannot decipher what is written on the floppy diskettes. The humans first write the program on paper files. Then they transfer the same to the machine decipherable media—the floppy diskette—using the computer itself or suitable data entry machines. When you store a number of programs in a file, you must be able to call any one program at a time. For this purpose, programs are labelled or given names. A program name is coined as per certain rules. The general form for a program name is

X.L

where L is a three-character code indicating the language in which the program is written, called the secondary name. Since we write the program in FORTRAN, we give the secondary name as FOR. The letter X stands for what is called the primary name coined by combining a maximum of eight characters suggestive of the nature of the program.

Suppose you are writing a program for payroll, you can give the primary name as PAYROL. The primary and the secondary names are separated by a period. The program names in the different languages are:

PAYROL.FOR	(in FORTRAN)
PAYROL.COB	(in COBOL)
PAYROL.BAS	(in BASIC)
PAYROL.PL1	(in PL/1)
PAYROL.PAS	(in PASCAL)

You can access any program in the file by calling its name, just as we access any person by calling his name.

A FORTRAN program for finding simple and compound interest

We will now make use of the statements we have studied so far and see how we can organise a FORTRAN program for finding the simple and compound interest for a principal P, at a rate of R per cent and for a period of N years. Input statements are given to access the data through the console. The program looks as shown in Box I.

Explanation of the program

The FORTRAN program shown in the Box I has 13 lines. The first statement is a comment statement, since it starts with letter C in the first column. The information meant for the readers is called documentation. By documentation we mean any explanation, verbal or pictorial, given to the readers for the understanding of the problem and the program. The second and the third lines contain the WRITE-FORMAT pair statements for printing a prompt string to tell the programmer about the values to be entered through the console.

Box I

```
C       PROGRAM FOR FINDING SIMPLE & COMPOUND INTEREST
        WRITE(1,20)
 20     FORMAT(1X,'ENTER THE VALUES FOR P,R &N: ')
        READ(1,21) P,R,N
 21     FORMAT(2F7.2, I3)
        SI = P*R*FLOAT(N)/100.0
        CI = P*(1.0+R/100.0)**N - P
        WRITE(1,22)
 22     FORMAT(1X,'PRINCIPAL RATE YEARS S.INTEREST C.INTEREST')
        WRITE(1,23) P,R,N,SI,CI
 23     FORMAT(F10.2, F5.1, I6, 2F11.2)
        STOP
        END


ENTER THE VALUES FOR P,R &N: 100.0,10.0,5

PRINCIPAL RATE YEARS S.INTEREST C.INTEREST
   100.00 10.0     5      50.00      61.05
```

The fourth and the fifth lines give the READ-FORMAT pair statements to get the data through the console. The sixth line contains the computation statement for computing the simple interest. In order to convert the integer variable N to real, the library function FLOAT (N) is used. The seventh line contains the computation statement for computing the compound interest. The eighth and the ninth lines contain the WRITE-FORMAT pair statements for printing the headings. The tenth and the eleventh lines contain the WRITE-FORMAT pair statements for printing the results under the proper headings. The twelfth line contains the STOP statement while the thirteenth line contains the END statement. These two statements require further explanation which is given below.

The STOP and the END statements

Any program written in a high-level language is processed in two stages. The first stage is called the compilation stage and the second stage is called the execution stage. During the compilation stage the computer reads the high-level language program, called the source program, and checks up the grammatical correctness of the statements and, if all the statements are correct, it converts the source program into the machine language program called the object program.

We have already pointed out that whatever the language in which you write the program, the computer can execute the program only if it is in the machine language. If there are grammatical errors, the computer will print those errors. The programmer has to correct those errors and again submit the program for compilation. It is only during the compilation stage that the computer uses the END statement. The END statement tells the computer that there are no more FORTRAN statements pertaining to that program. Hence, the END statement will occur at the physical end of the program. The END statement is said to be the logical conclusion of the source program.

Once the compilation is successful, the computer will give a NO ERRORS message, thereby implying that the source program has been converted to the object program or the machine language program. When the computer gives the signal that the compilation is successful, the operator gives the execution command. During the execution stage, the computer executes the statements in the sequence in which they are listed and finally, on encountering the STOP statement, it literally halts the operations after printing the word STOP.

Remember that the END statement does not appear in the object program. The last executable statement in the object program is the STOP statement and we say that the STOP statement is the logical conclusion of the object program. Once the STOP statement is executed, the entire program is erased from the main memory and the control is said to be returned to the operating system. It is the operating system residing in the computer that manages all the programs given by the users. If you want the program to be re-run, you have to give the execution command once again.

It may be noted that there may be more than one STOP statement in a program depending on the problem logic, but there can be only one END statement at the physical end of the program. The five lines at the end of Box 1 show the output. When the computer encounters the READ statement, it halts until the operator enters the data for the variables P, R and N through the console. The computer then prints the headings and the results as shown in the last two lines.

FORTRAN program using the data statement

In the last example, we saw how we can give instructions to the computer to get the data through the console. Suppose you want to enter data in the program itself, it can be done by using the DATA statement. The four statements which occur immediately after the comment statement are replaced by the data initialisation statement or the DATA statement as follows:

```
DATA P, R, N/100.0. 10.0, 5.0/
```

There is no change in the other statements. In this program the data for the input variables P, R and N are initialised in the DATA statement.

One drawback in this method is that, if we want to compute SI and CI for another set of values, we have to change the program. That is, the DATA statement must be rewritten with another set of values and the whole program has to be re-compiled. In the former case there is no re-compilation, but there is only re-execution. When the data are given in the DATA statement, the READ-FORMAT pair statements are removed, otherwise the program looks the same. The output will remain the same as shown in the last two lines of Box 1.

Structure of a FORTRAN program

A FORTRAN program is organised as a sequence of statements each of which is either an instruction or an information to the computer or the reader. The statements which give information to the computer belong to the class of declaration statements and they are non-executable. The statements which give information to the readers are called the comment statements and they are also non-executable. By structure we mean the arrangement of the constituents of the system.

By system we mean an organisation made of interrelated elementary functional units. The smallest logical unit of a FORTRAN program is the statement. A FORTRAN program is organised by a series of statements which are logically related to each other. The structure of a FORTRAN program can be schematically represented as shown below.

Each line represents a statement. The series of lines, one after the other, denote the series of statements written, one after the other. Remember that there is a logic in the sequence. This means that if the positions of the statements are changed, the entire meaning will be changed. Simple FORTRAN programs involving straightforward logic can be organised as above. Later we will discuss how programs involving complex logic can be organised.

Structure of a COBOL program

A COBOL program is made of statements just like FORTRAN. But the statements in a COBOL program are grouped in a structure similar to that of a textbook. Just as a textbook is divided into chapters, and chapters are divided into sections and sections are divided into paragraphs and paragraphs are divided into sentences, a COBOL program is divided into four named divisions and divisions are divided into one or more named sections and sections are divided into one or more named paragraphs and paragraphs are divided into one or more sentences and sentences are divided into one or more statements.

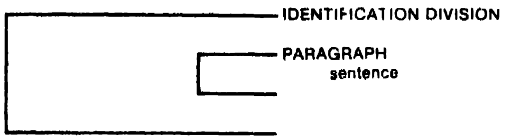
A COBOL program enforces further discipline in the structure by allotting well defined places in the program for giving the different specifications or declarations. It consists of four divisions, each with its own logical position and function in the program. The four divisions are:

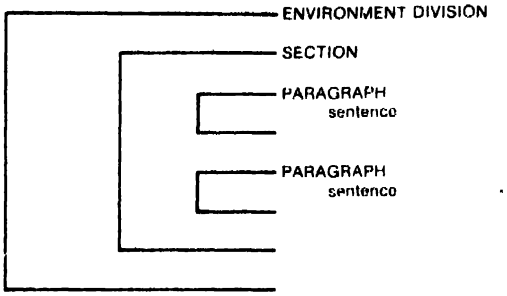
1. IDENTIFICATION division
2. ENVIRONMENT division
3. DATA division
4. PROCEDURE division

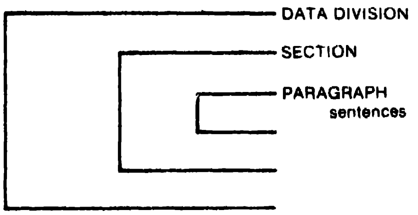
Of these four divisions, the actual commands for performing the computations are contained only in the PROCEDURE division. The other three divisions are there only to give information to the computer about the name of the program, the peripheral devices used, the descriptions of data types and so on. Such elaborate formalities are required by COBOL because of the nature of the problem it has to handle.

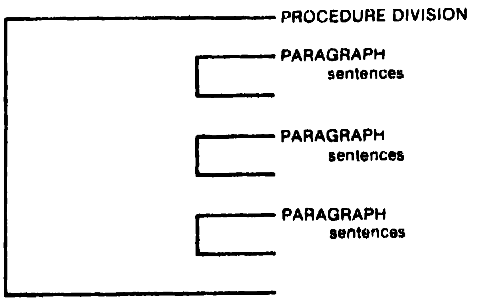
We know that a computer uses two things, namely the program and the data. Data can be either structured or unstructured. It is mandatory in COBOL to declare all data, whether they are input or output or generated in the program. The form of declaration for the structured data is different from the instructional data. Now we will consider the structure of a COBOL program which deals only with unstructured data.

A schematic representation of the structure of a COBOL program is shown below:









Rules for key-punching COBOL programs

The COBOL programs are said to be column oriented. This means that different entries must be made from different columns in each line. Each line consists of 80 columns. One character can be punched in each column. There are two margins in the COBOL program and they are called the A-margin and the B-margin. A-margin starts from the eighth column and the B-margin starts from the twelfth column. All divisions, sections and paragraphs have labels or names. These names must be punched from the A-margin. Later we will see that certain level numbers like FD, 01, 77 etc also must be punched from the A-margin.

All sentences and certain level numbers like 88 must be punched from the B-margin. Sentences cannot be keyed beyond column 72. Columns 73 to 80 must be left blank. If one wants to key comment statements, it can be done by putting an asterisk symbol in the seventh column. Every line that contains a comment statement must have an asterisk symbol in the seventh column. Statements can be continued from one line to the next without any restriction, provided you don't break a word. But if a sentence is terminated in one line, a second sentence cannot be keyed from the same line, i.e. more than one sentence cannot be keyed in a line.

It must be noted that statements are separated by blanks and sentences are terminated by periods. The period is a necessary punctuation in COBOL to indicate the termination of sentences, division headers, section headers and para headers. Improper punctuation will give rise to syntax errors.

We will now give some explanations about the entries made in the various divisions. There are difficulties in explaining completely each of these divisions one by one, since in order to understand some entries in one division we must understand their functions in other divisions. This interdependence is somewhat confusing to the beginners, but things will become clear when one gets an overall picture of a COBOL program. Till then the readers should patiently go through the ordeal.

IDENTIFICATION division. This is the first division of a COBOL program. The function of this division is to specify the name of the program by which it will be known to the computer. This division has only one function and so it has only one para. The mandatory entries in the IDENTIFICATION division are

```
A   B
IDENTIFICATION DIVISION.
PROGRAM-ID.
name of the program as coined by the programmer.
```

The first entry is the name of the division, and is identified by the word division and its location. The division header must be punched from the A-margin. The period at the end of the word division is a necessary punctuation. There are no sections in this division. There is only one mandatory paragraph whose name is PROGRAM-ID. The pragraph label must also be punched from the A-margin. The entries must be made from the B-margin.

In this case, the entry is the program name which is coined by the programmer following the same rules for coining data names. A typical name can be PAYROLL. There are some optional paragraphs in this division which are used for documentation purposes. Since these paragraphs are not mandatory, the beginners need not worry much about them. A typical example of entries with the one mandatory paragraph is given below:

```
IDENTIFICATION DIVISION.
PROGRAM-ID. [illegible]
```

Uttarpara [illegible] Public Library

The IDENTIFICATION division is the simplest one in the COBOL program and its description is complete, and so we will not come back again to this division since its interdependence with other divisions is little.

ENVIRONMENT division. This is the second division in a COBOL program with two functions, and they are done by two sections. The functions are:

1. To give the names of the computer which compile and execute the program
2. To give the names of peripherals which handle the input and the output files.

And the two sections are:

1. CONFIGURATION section
2. INPUT-OUTPUT section

The CONFIGURATION section is composed of two mandatory paragraphs, namely the SOURCE-COMPUTER, the OBJECT-COMPUTER and one optional paragraph, namely, the SPECIAL-NAMES para. The SPECIAL-NAMES para is used only when one has to connect some system defined names with some programmer coined names. We will see its use later.

The INPUT-OUTPUT section is required only when files are used. Presently we will omit it since we are going to consider independent data items alone. The typical entries in the ENVIRONMENT division of a COBOL which uses only independent data items are shown below:

```
A   B
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER. ORION 8000.
OBJECT-COMPUTER. ORION 8000.
```

DATA division. The function of this division is to describe the organisation of the data that will be used in the program. It is composed of two sections, namely the FILE section and the WORKING-STORAGE section. In the FILE section we describe the file data (that is data items present in the input and the output files alone) and in the WORKING-STORAGE section we describe all the independent data items. The typical entries in the DATA division which uses only independent data items are shown below:

```
A   B
DATA DIVISION.
WORKING-STORAGE SECTION.
77 data-name PIC string of A's or X's or 9's
77        "           "
" " " " " " " " " " " " " " " " " "
" " " " " " " " " " " " " "
```

PROCEDURE division. The function of this division is to do all processings with the data and output them in the desired format and in the required devices, either on the printer or on the disc or on the screen. It must be noted that all data used in this division must have been completely described in the DATA division. There is a lot of interdependence between PROCEDURE division and the DATA division. The structure of the PROCEDURE division is shown below:

```
A   B
PROCEDURE DIVISION.
para-header.
    entries.
para-header.
    entries.
" " " " " " " " " " " "
        " " " " " " " " "
" " " " " " " " " " " "
        " " " " " " " " "
```

In this division we give all the commands to perform the various jobs like reading the data, computing the expressions, printing the results etc.

The commands are given by what are called statements. Statements can be grouped to form a sentence. Sentences can be grouped to form a single logical unit called a paragraph. If necessary, the paragraphs can be grouped to form a section. Normally we do not have sections in the PROCEDURE division. It may be noted that the section headers and the para headers in this division are all programmer-coined.

Summary

COBOL program consists of four divisions, each with its own logical positions and functions. Since these divisions are somewhat interdependent we cannot study these divisions independently one after the other. In other computer languages like FORTRAN or BASIC, one can start writing complete programs after learning to coin statements. But in COBOL one has to study the various formalities required to be entered for writing a complete program.

Now that we have studied the essential statements to write a COBOL program which uses only independent data items and also the formalities to be obeserved in writing the various statements in the different sections, we will consider a typical COBOL program for finding the simple and the compound interest in the next article. You will find that the statements in the first three divisions are only declaration statements and their function is to give information to the computer about the program and the data which it uses. So we call them non-executable statements, whereas the statements in the last division, PROCEDURE division, are said to be executable statements.

(To be continued)

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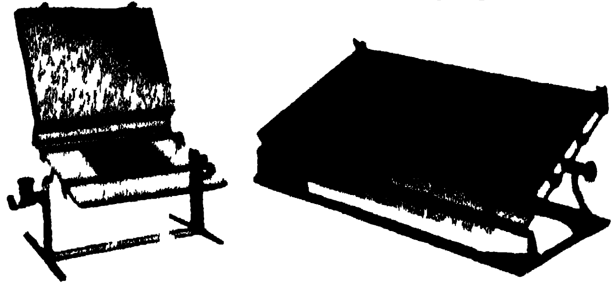

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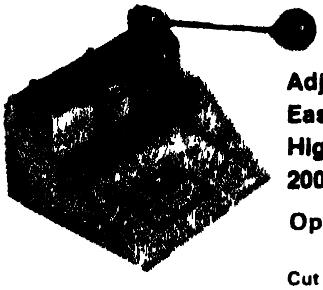

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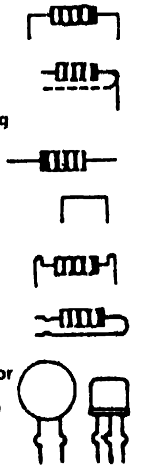

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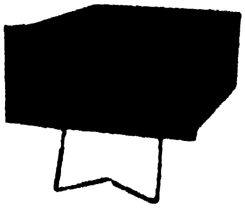

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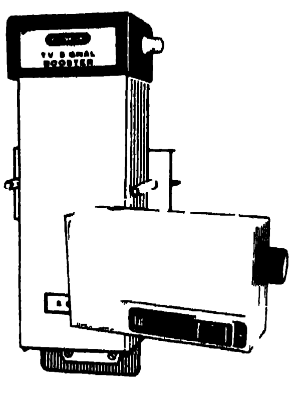

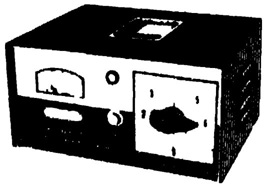

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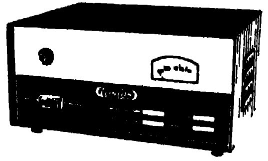

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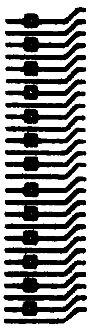

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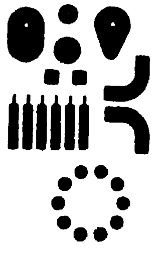

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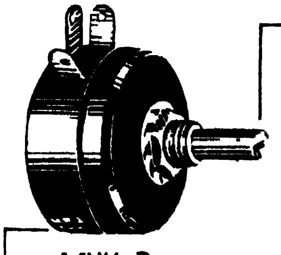

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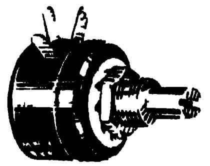

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Sound Activated Flash for 'Stop Action' Photography

Vivek Mehra

Here's how to capture those different stages of the bursting of an electric bulb, or the impact of a milk drop in a bowl. Recording these transient moments would be rather difficult by any technique other than 'stop action photography'.

This technique is not half as difficult as it seems at first glance—the camera is first focussed at the place of 'action' (action implying the bursting of the bulb or the drop striking the bowl). The room is then completely darkened, and the camera's shutter is kept at 'B' (shutter open).

The sound made by the action triggers the flash after a delay which can be altered by the circuit. The flash duration is normally 0.25 to 1 millisecond which is sufficient to freeze even the fastest action.

Once the flash is triggered, the shutter is closed, and a fresh photograph can be taken with a different delay to record another stage of the event

The circuit

The main component of the circuit is an LM324 quad op-amp. The use of just one IC and the PCB design simplifies fabrication. It is to be used in conjunction with a capaci-

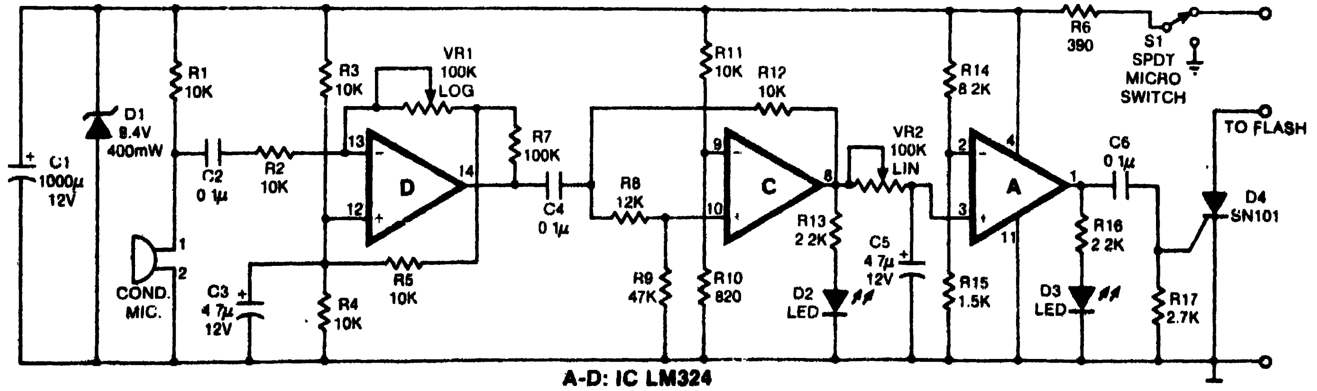


Fig. 1: The circuit diagram of the sound activated flash.

PARTS LIST

Semiconductors:	
IC1	— LM324 quad op-amp
D1	— 8.4V, 400mW zener diode
D2, D3	— Light emitting diode
D4	— SN101 silicon control rectifier
Resistors [all 1/4 watt, ±5% carbon]:	
R1, R2, R3, R4, R5, R11, R12	— 10-kilohm
R6	— 390-ohm
R7	— 100-kilohm
R8	— 12-kilohm
R9	— 47-kilohm
R10	— 820-ohm
R13, R16	— 2.2-kilohm
R14	— 8.2-kilohm
R15	— 1.5-kilohm
R17	— 2.7-kilohm
VR1	— 100-kilohm log. potentiometer
VR2	— 100-kilohm lin. potentiometer
Capacitors:	
C1	— 1000μF, 12V electrolytic
C2, C4, C6	— 0.1μF ceramic
C3	— 4.7μF, 12V electrolytic
C5	— 4.7μF, 16V electrolytic (see text)
Miscellaneous:	
S1	— SPDT microswitch
	— Condenser microphone, PCB, shielded wire, enclosure, hardware etc.

tor discharge flash gun.

Broadly, the circuit can be divided into the following stages:

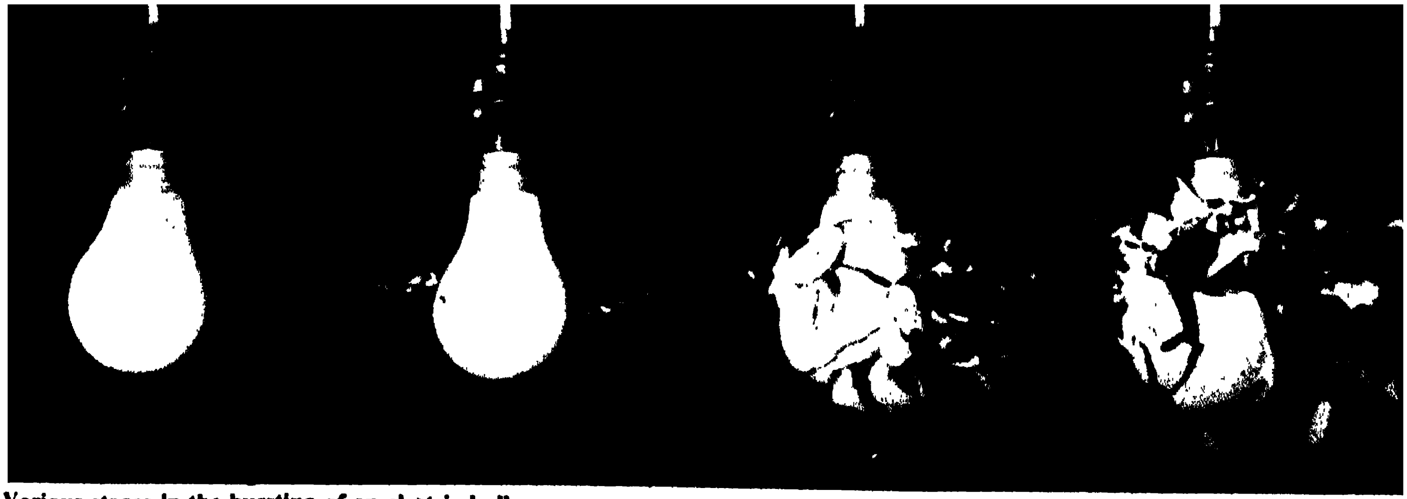
Sound amplifier. A condenser microphone serves as a sensitive and economical transducer. Resistor R1 provides bias for the in-built FET amplifier of the condenser microphone. Op-amp D is connected in the inverting amplifier configuration.

Gain of this stage, and hence the sound level at which the circuit triggers the flash, can be set by potentiometer VR1. In case the gain is not sufficient, replace resistor R2 with 4.7k or 2.2k or R7 with 4.7k by trial and error. In the prototype, this arrangement for gain was found to be more than adequate.

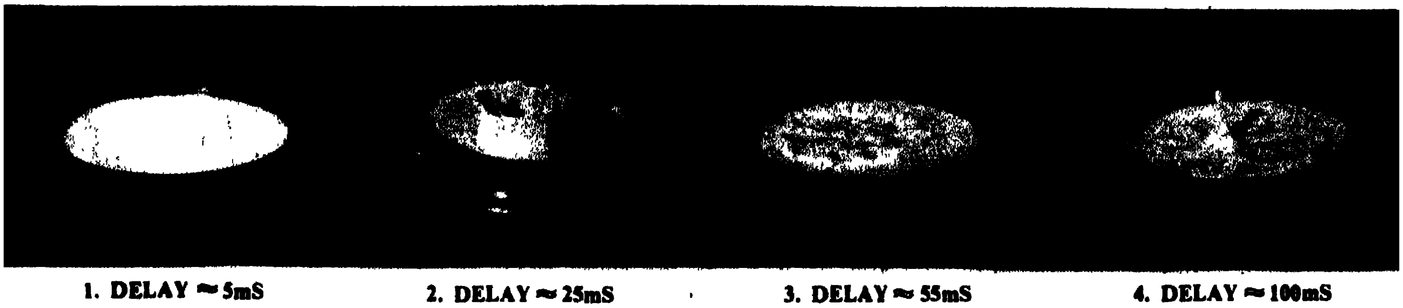
Latch. A noise impulse causes the voltage at the non-inverting (+) pin of op-amp C to exceed that at the inverting (-) terminal, and the output swings high. Due to positive feedback of R12, the output latches to positive saturation. The LED lights up indicating latching action. This enables reliable triggering of the next stage, and prevents re-triggering once a photo has been taken.

Delay. The output of op-amp C in the untriggered state is low, and capacitor C5 is in the discharged condition. Once the previous stage latches, the timing (delay) cycle is initiated. The rate of charging is controlled by the resistance of potentiometer VR2 and the capacitance of C5.

When the voltage across C5 exceeds that set by the poten-



Various stages in the bursting of an electric bulb.



1. DELAY ≈ 5mS **2. DELAY ≈ 25mS** **3. DELAY ≈ 55mS** **4. DELAY ≈ 100mS**

Various stages recorded after the impact of a milk drop in a shallow bowl.

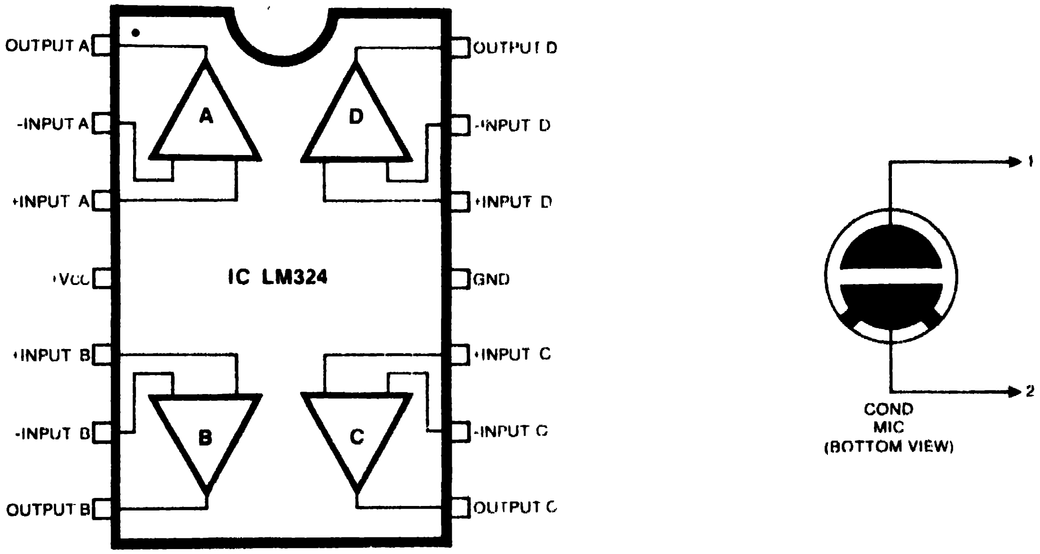


Fig. 2: The pin configuration of LM324 and the condenser microphone connections.

tial divider comprising R14 and R15, the output of op-amp A goes high, and the LED lights up. This delay is linearly dependent on the position of potentiometer VR2. (The maximum delay is given by the formula T=20C, where T is in milliseconds and C is in microfarads. Thus, by changing the value of C5 the maximum delay can be varied.)

Flash trigger. The flash gun contacts are connected to the SCR, observing proper polarity. The instant the output of op-amp A goes high, the SCR is triggered and the flash gun fires.

Once the circuit is triggered it remains in the latched state. It can be deactivated by depressing switch S1 for a period of three to four seconds.

Taking the photographs

As explained earlier, the photographs are taken in a darkened room. The most important variable is the time delay,

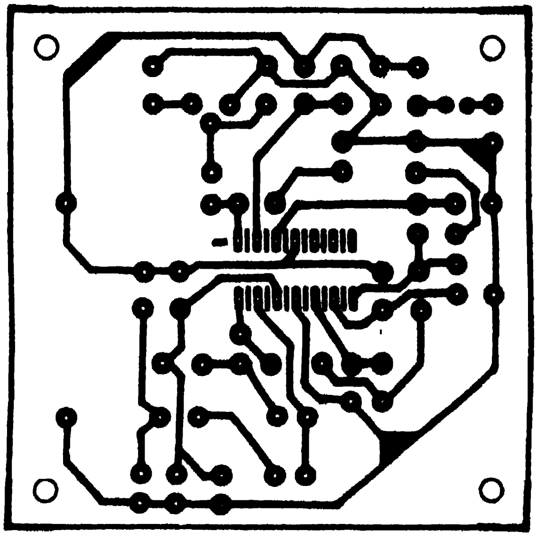
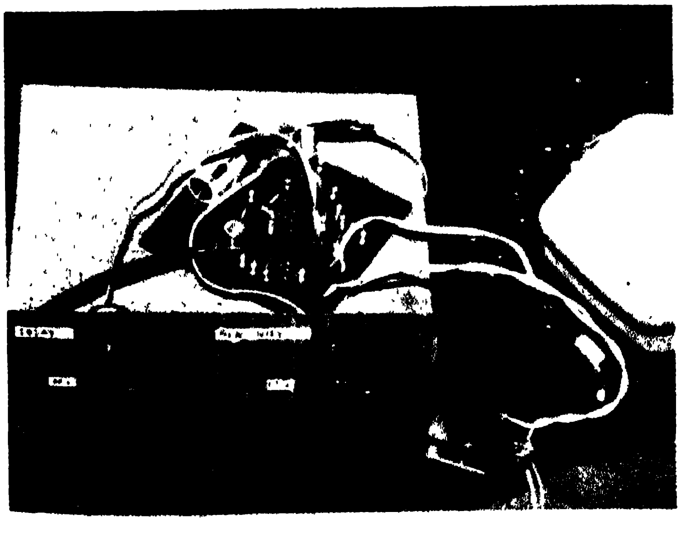


Fig. 3: Actual-size PCB layout of the sound activated flash.



A view of the author's prototype showing microswitch S1 and milk bowl in which the drops were made to fall.

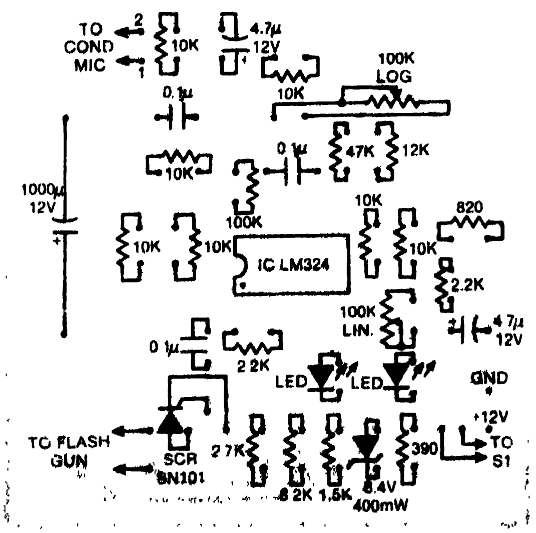


Fig. 4: Components layout for the above PCB.

which is obtained experimentally. A number of trial runs are made to set the sensitivity and delay.

In the photos of the milk drop, the drop was made to fall from a height of one metre into a bowl just filled to cover the bottom surface. As sound made by the drop was quite faint, the microphone was taped to the lower surface of the bowl. As seen in the series of photographs taken, the most interesting formation was at a delay of about 25 milliseconds after the drop struck the bowl.

In the different stages of the bulb bursting, the bulbs were shot with the help of an airgun. A thick cloth sheet was hung behind the bulb to eventually catch the pellets.

Care should however be taken to adjust the sensitivity of the circuit so that it does not trigger at the sound of the gun. This can easily be achieved by keeping the microphone closer to the bulb than to the gun. □

This project was designed and tested by the author. The circuitry was retested 'partly' in EFY lab. The photographs were all taken by Mr Sushil Narula and the author

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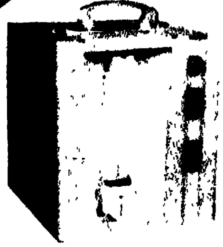

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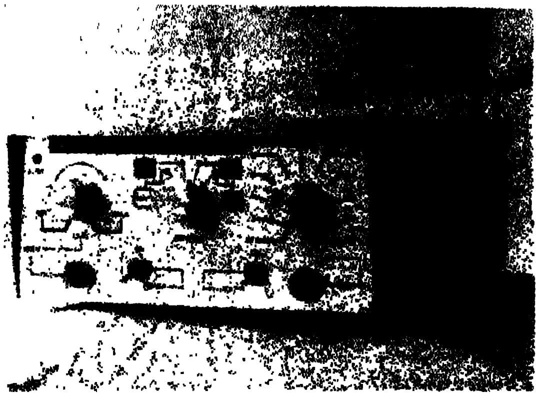

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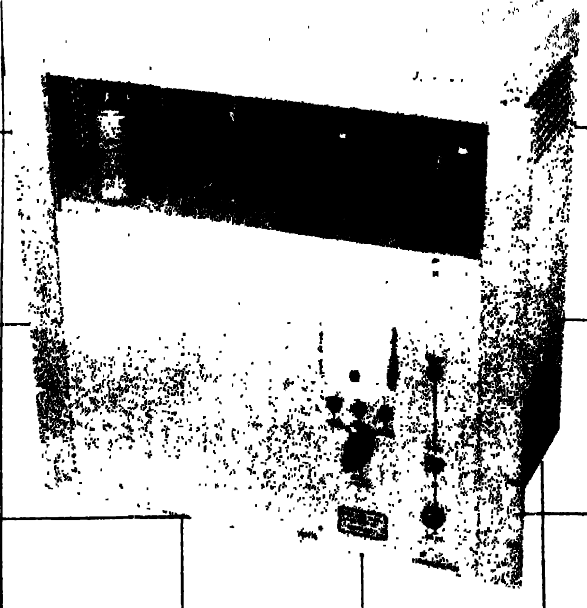

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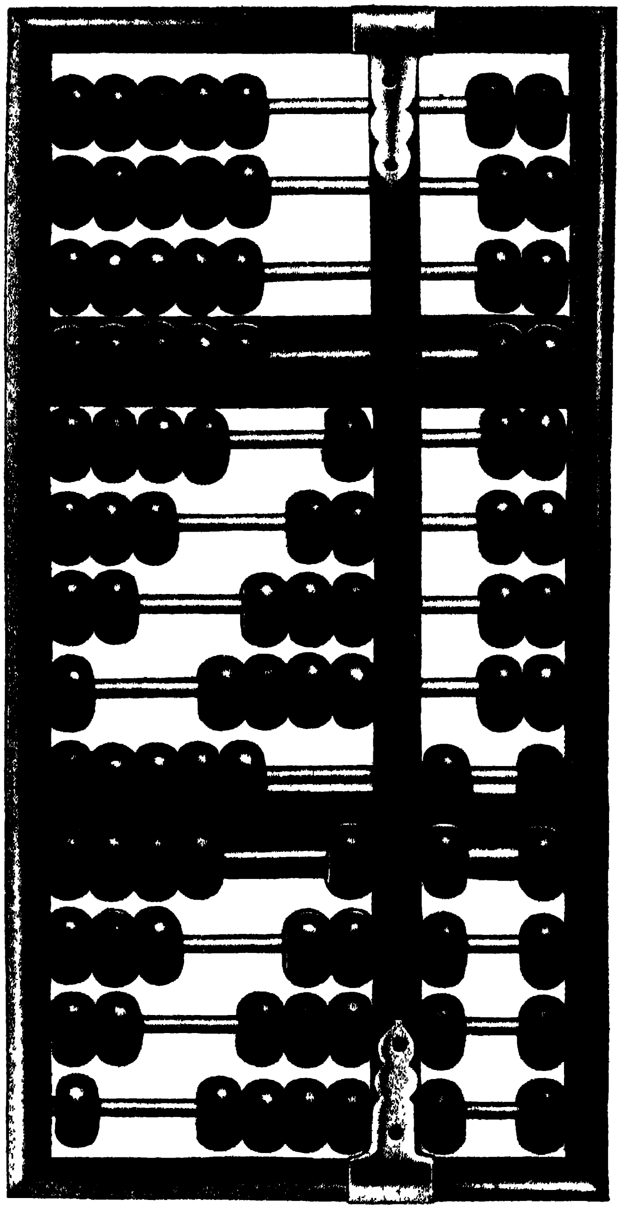

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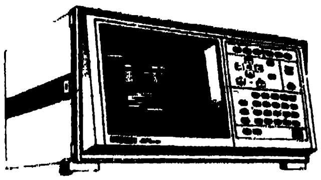

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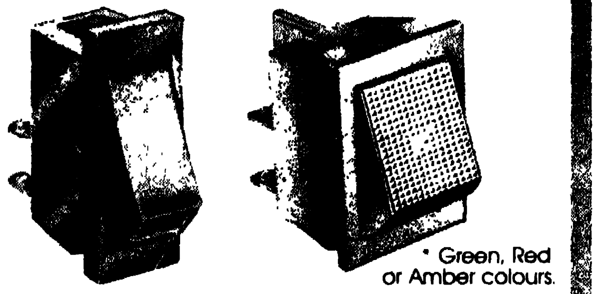

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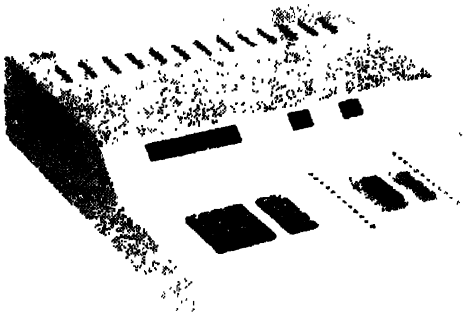

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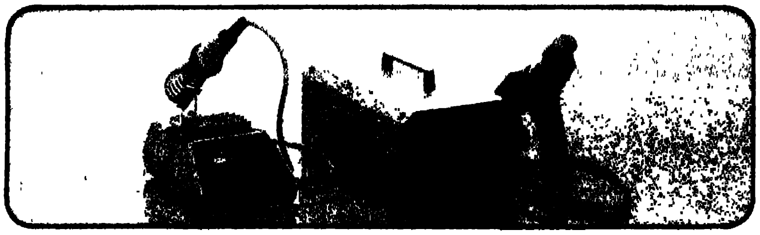

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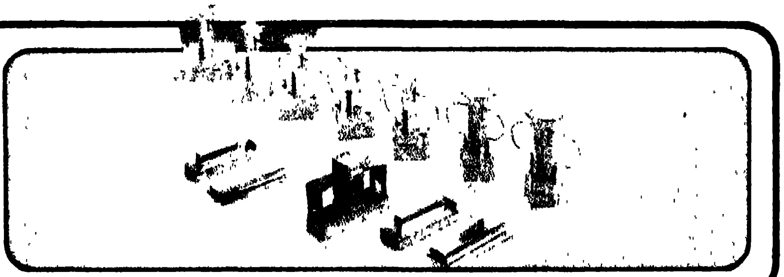

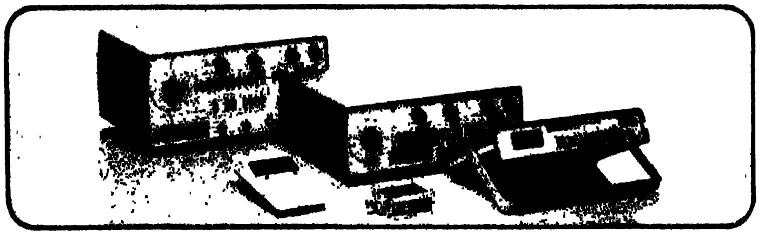

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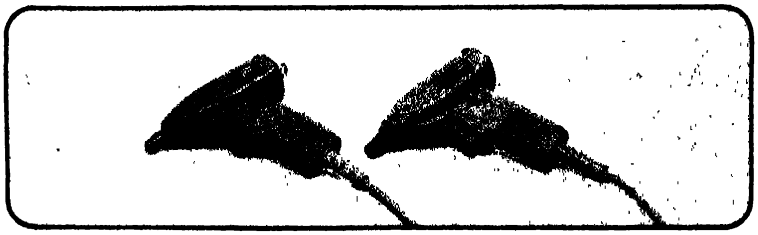

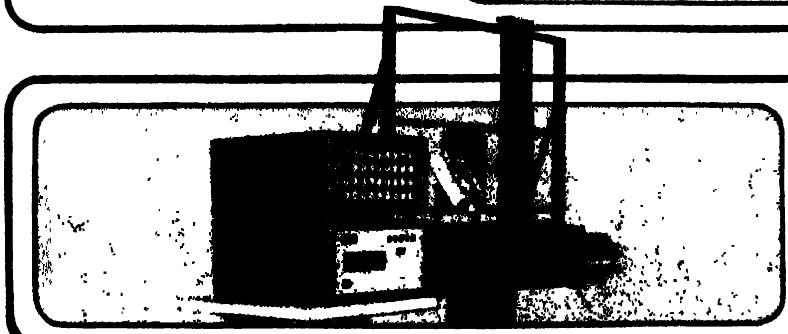

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10-Band Graphic Equaliser

C. Sanjay

Until now, many articles on power amplifiers, tone controls, preamplifiers, etc have appeared in EFY. These articles can help one make a stereo system on one's own. Sometimes, when one is fond of changing the tonal quality of the programme, or when one is in the habit of making duplicate cassettes from original sound tracks, an equaliser—properly known as a Graphic Equaliser—seems indispensable. Moreover, graphic equalisers offer greater control over the quality of music than a simple tone control system with just bass and treble controls.

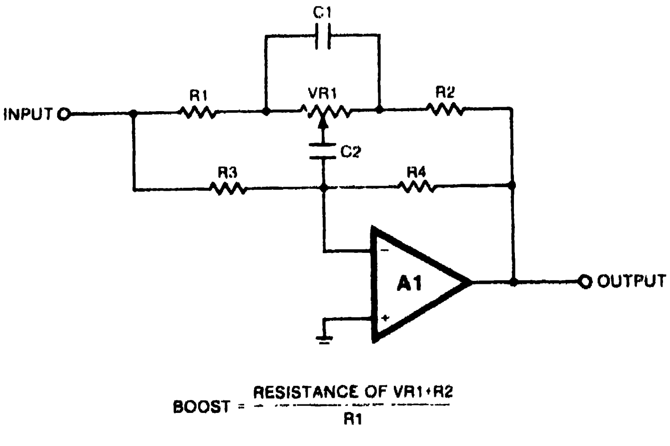
There are many types of equalisers—ranging from 10-band equalisers to something like a 30-band graphic equaliser. However, for all practical purposes, a 10-band graphic equaliser—also known as First Octave Equaliser—is more than sufficient for a good home system. This article deals with the construction of a high quality, low distortion 10-band graphic equaliser. The specifications are given in Table I.

This first octave graphic equaliser has ten controls for ten different frequencies, which have a definite relationship with each other. The relationship can be noticed easily by observing the numerical values of the frequencies for which the controls are provided, viz, 32 Hz, 64 Hz, 125 Hz, 250 Hz, etc. Except for the relation between 64 Hz and 125 Hz, the ratio between any two adjacent frequencies is 1:2. The frequencies could have been 32 Hz, 64 Hz, 128 Hz, 256 Hz, etc, but this would also make the values look odd. For example, 1 kHz 'sounds' better than 1.024 kHz, although the latter is what one will get actually if one goes on doubling the values of frequencies from 32 Hz.

The basic circuit

The basic building block of this equaliser is very much different from the usual ones that we often see in articles in EFY. Fig. 1 shows a 'normal' equaliser portion while Fig. 2(a) shows the type that is used in our equaliser. One can easily find out the main difference. While the portion of a 'normal' equaliser in Fig. 1 uses capacitors to fix the frequency, a tuned circuit is used in Fig. 2(a).

The disadvantages of the circuit shown in Fig. 1 are that



$$\text{BOOST} = \frac{\text{RESISTANCE OF VR1+R2}}{\text{R1}}$$

$$\text{CUT} = \frac{\text{R2}}{\text{RESISTANCE OF VR1+R1}}$$

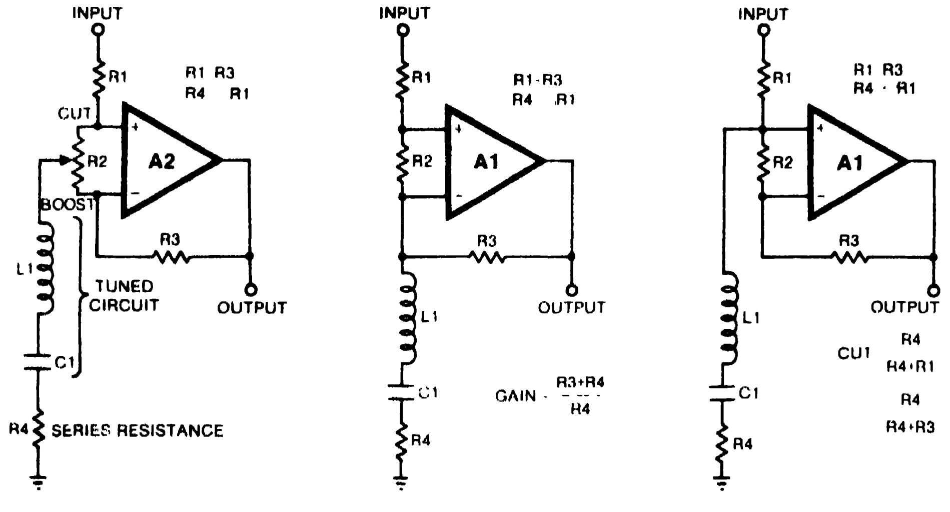
$$\text{C2} = \frac{\text{C1}}{10}$$

R4 AND R3 ARE USUALLY AROUND 1M

Fig. 1: Schematic showing a part of a normal equaliser.

TABLE I

Number of bands	: 10 (32 Hz, 64 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, 16 kHz)
Boost/cut on each band	: ±15dB
THD% (At V_{OUT}=1V)	: < 0.05%
S/N Ratio	: >80dB
Input impedance (Z_{IN})	: 100k
Output impedance (Z_{OUT})	: <150 ohms
Input voltage for V_{OUT}=1V	: 180mV
Max. input voltage	: 10V
Max. input voltage for undistorted sound	: 2.5V



(a) (b) (c)

Fig. 2: Equaliser section using tuned circuit:(a) in 'flat' condition . (b) in 'boost' condition , (c) in 'cut' condition.

the roll-off is not sharp (or steep), and the amount of cut or boost that is obtainable in a 10-band equaliser of this type is low. When a 10-band equaliser of the type shown in Fig. 1 is made, the gain or cut must be limited in such a way that boosting a frequency does not interfere with the next frequency or the one preceding it. If the circuit shown in Fig. 2(a) is used, the 'Q' and gain can be easily varied to an extent that even 30-band equalisers are possible.

Fig. 2(b) shows the equaliser section in full boost condition. If the resistance of the tuned circuit is considered very small, then the only resistive element is R4. The gain is now conveniently given by the relationship (R3+R4)/R4. By making R4 low, and the value of R3 high, high gain can be obtained. If 'Q' of the inductor is made high, then the effect of one control on its adjacent bands will be very very small.

Fig. 2(c) shows the same equaliser section under full cut condition. Now the input voltage is divided between R1 and R4. Since R4 is very small, a part of the input signal appears across R4. The op-amp A1 will not produce any gain now and acts as a buffer. The loss in voltage or the cut can now be given by R4/(R3+R4).

For low frequencies such as 32 Hz and 64 Hz, the size of inductor L1 will become very big—not only in value but also physically. So when a 10-band stereo equaliser is made, the inductors alone will occupy the entire cabinet. Anyway, this is not what we want. To overcome the problem, simulated inductors are used.

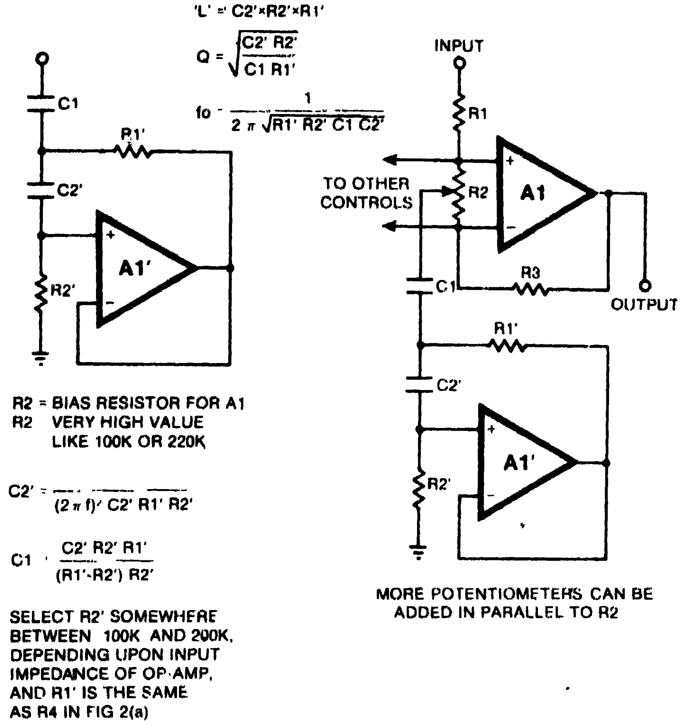
For those who are not familiar with simulated inductors, some details about designing a simulated inductor are given in Fig. 3(a). Here, C1 is the series tuning capacitor while all the other components make up the simulated inductor. Full details to explain the working of the simulated inductor are not given here due to limitations of space. However, the formulae in Fig. 3(a) should help readers design one by themselves. Fig. 3(b) shows an equaliser section using this simulated inductor.

The circuit

The complete 10-band equaliser circuit using twelve op-amps (three TL084s) is given in Fig. 4. Op-amp A1 is an input amplifier with a gain of 5.5. The output of this op-amp is connected to the group of potentiometers that are used to boost or cut specified frequencies. Capacitor C2 serves to filter very high frequencies to some extent. The op-amps A2 to A11 make up the simulated inductors. Op-amp A12 is the active part that actually boosts or cuts any band of frequencies. This A12 can be considered as the op-amp A1 in Fig. 3(b).

The power supply section is not at all complicated and therefore needs no explanation. The supply to each IC (TL084) is connected through two 10-ohm resistors and is decoupled with 0.1μF capacitors.

The potentiometers can be of any type, sliding or rotory. But the controls should be logarithmic ones; their resistance should change slowly at both ends and quickly in the middle. This type of control is necessary because as the value of the resistance between the wiper and any one end of the control approaches 470 ohm, the control becomes very sensitive. To overcome this problem, logarithmic controls of the above-mentioned type must be used.


'L' = C2'×R2'×R1'
Q = √(C2' R2' / C1 R1')
fo = 1 / 2π √(R1' R2' C1 C2')
C1
R1'
C2'
A1'
R2'
R2 = BIAS RESISTOR FOR A1
R2 VERY HIGH VALUE LIKE 100K OR 220K
C2' = 1 / (2πf)² C2' R1' R2'
C1 = C2' R2' R1' / (R1'-R2') R2'
SELECT R2' SOMEWHERE BETWEEN 100K AND 200K, DEPENDING UPON INPUT IMPEDANCE OF OP-AMP, AND R1' IS THE SAME AS R4 IN FIG 2(a)
INPUT
R1
TO OTHER CONTROLS
R2
A1
R3
C1
OUTPUT
R1'
C2'
A1'
R2'
MORE POTENTIOMETERS CAN BE ADDED IN PARALLEL TO R2

(a) (b)

Fig. 3: Simulated inductor: (a) basic design consideration; (b) incorporation in equaliser.

Construction

The construction should not be difficult if a PCB is used. A possible actual-size PCB pattern for a mono equaliser is shown in Fig. 5. Two of these boards are required to make a stereo version. The component layout is given in Fig. 6. The power supply circuit diagram to obtain a regulated ±15V dual power supply is shown in Fig. 7. PCB pattern for the power supply is shown in Fig. 8, and its component layout in Fig. 9.

As far as possible use polycarbonate (metallised) or polyester capacitors. The only problem components are the 4.7μF, 2.2μF, 1.2μF and the 0.56μF capacitors. If you are unable to get a 0.56μF polyester or polycarbonate capacitor, use a ceramic capacitor. In this case it is better to try with two or three capacitors until you get the best possible effect from the equaliser.

For 4.7μF, 2.2μF etc, two tantalum capacitors can be used in back-to-back configuration. If nothing is available, use a high voltage (around 100V) 4.7μF electrolytic capacitor. But before soldering it compare it with some other capacitor of known value and verify that the capacitor is really 4.7μF in value.

In component layout (Fig. 6) all the values of capacitors are given for each frequency band as per Table II. Table III will help you identify which capacitors are used for which frequencies. You can also do this by looking at the marking near the control to which the capacitors are connected in case of any doubt.

Another point about the values of capacitors: Capacitors with values like 100 pF and 680 pF can be of ceramic disc type.

The 1.2μF capacitor can be difficult to obtain. In that case two capacitors of 1μF and 0.2μF are connected in parallel and solder them to the board.

As far as possible, standard values have been chosen. Wherever you are unable to get the specified value, use a very high voltage electrolytic capacitor whose capacitance is known to be the value specified. If you have a capacitance meter of any kind, it can help you to get the correct capacitor.

The sliding controls can be fixed on a plain laminate and then fixed on to the panel of the cabinet from inside. This will prevent all the fixing screws from being seen outside. While earthing the shield of the shielded wire used for connecting the input socket (if used) to the board, earth the shield near the socket, and on the PCB.

In the power supply board try to use polyester capacitors for the two 0.22μF capacitors. Use 0.1μF disc capacitors for those which are used to decouple the supply after the 10-ohm resistors.

Checking and fault finding

First of all, before switching on, check whether you have connected the positive and negative supplies on to the PCB

TABLE II

	Values of			
Freq.	*C4*	*C5*	*C6*	*C7*
32 Hz	4.7 μF	0.56 μF	0.1 μF	—
64 Hz	2.2 μF	0.47 μF	0.05 μF	—
125 Hz	1.2 μF	0.15 μF	0.022 μF	2.7 kpF
250 Hz	0.68 μF	—	0.012 μF	—
500 Hz	0.33 μF	—	6.2 kpF	—
1 kHz	0.15 μF	0.02 μF	2.7 kpF	470 pF
2 kHz	0.082 μF	2 kpF	1.5 kpF	—
4 kHz	27 kpF	15 kpF	680 pF	100 pF
8 kHz	0.02 μF	—	390 pF	—
16 kHz	0.01 μF	—	200 pF	—

TABLE III

IC Pin No.	*Components [capacitors]*	
	connected to	*for frequency*
IC1		
5, 6, 7	C4, C5, C6	32 Hz
8, 9, 10	C4, C5, C6	64 Hz
12, 13, 14	C4, C5, C6, C7	125 Hz
IC2		
1, 2, 3	C4, C6	250 Hz
5, 6, 7	C4, C6	500 Hz
8, 9, 10	C4, C5, C6, C7	1 kHz
12, 13, 14	C4, C5, C6	2 kHz
IC3		
1, 2, 3	C4, C5, C6, C7	4 kHz
5, 6, 7	C4, C6	8 kHz
8, 9, 10	C4, C6	16 kHz

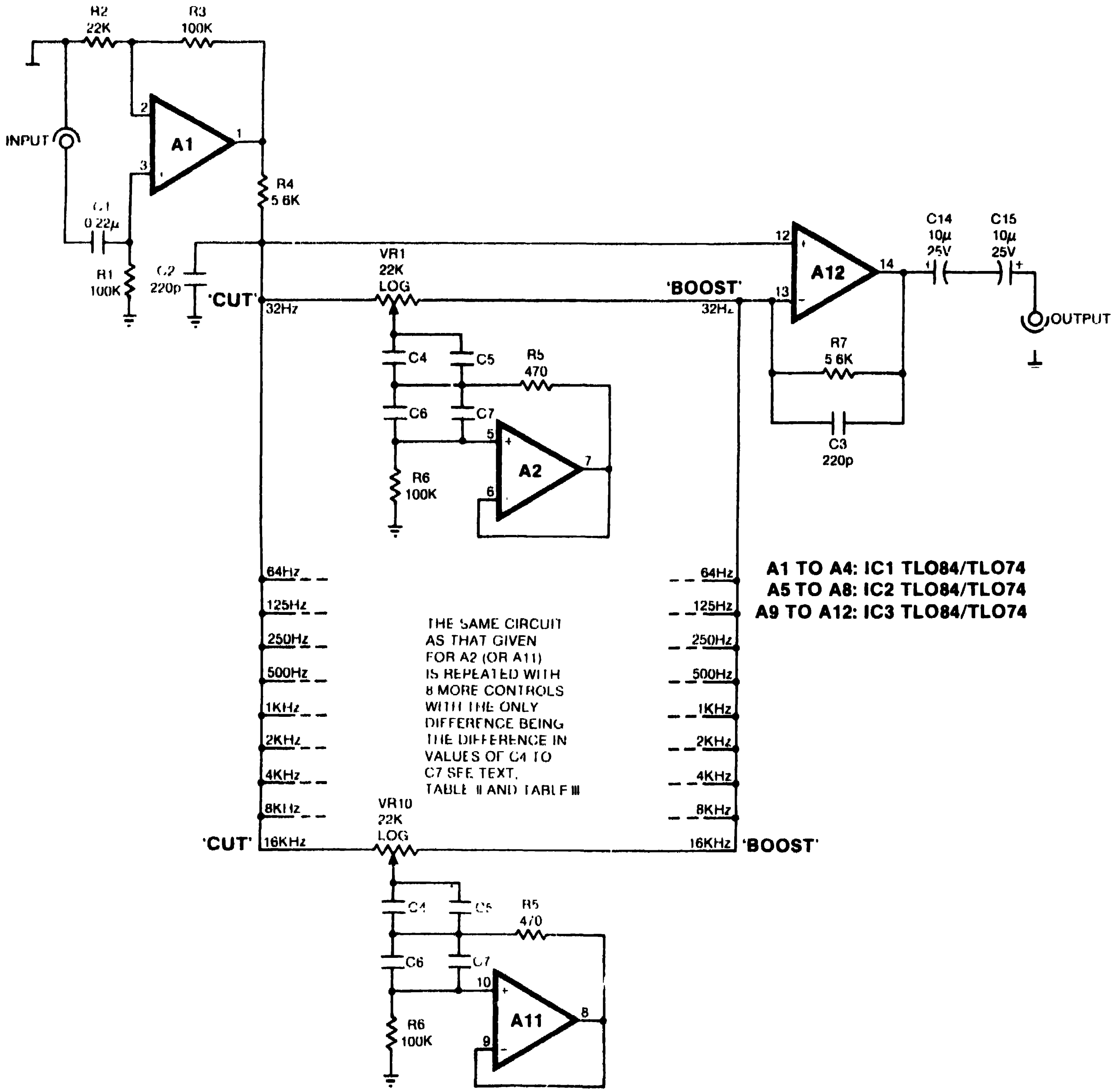

R2
22K
R3
100K
INPUT
A1
2
3
1
R4
5.6K
C1
0.22μ
R1
100K
C2
220p
'CUT'
32Hz
VR1
22K
LOG
'BOOST'
32Hz
12
13
A12
14
C14
10μ
25V
C15
10μ
25V
OUTPUT
R7
5.6K
C3
220p
C4
C5
R5
470
C6
C7
5
A2
7
6
R6
100K
A1 TO A4: IC1 TLO84/TLO74
A5 TO A8: IC2 TLO84/TLO74
A9 TO A12: IC3 TLO84/TLO74
64Hz
125Hz
250Hz
500Hz
1KHz
2KHz
4KHz
8KHz
16KHz
THE SAME CIRCUIT AS THAT GIVEN FOR A2 (OR A11) IS REPEATED WITH 8 MORE CONTROLS WITH THE ONLY DIFFERENCE BEING THE DIFFERENCE IN VALUES OF C4 TO C7 SEE TEXT, TABLE II AND TABLE III
VR10
22K
LOG
'CUT'
'BOOST'
C4
C5
R5
470
C6
C7
10
A11
8
9
R6
100K

Fig. 4: Circuit diagram of a first octave, 10-band graphic equaliser.

PARTS LIST

Semiconductors:
IC1-IC3 — TLO84/TLO74 Bi-FET quad op-amp
IC4 — LM7815, 15V positive voltage regulator
IC5 — LM7915, 15V negative voltage regulator
D1-D4 — 1N4002, 1-amp rectifier diode

Resistors [all 1/4 watt, ±5% carbon]:
R1, R3 — 100-kilohm
R2 — 22-kilohm
R4, R7 — 5.6-kilohm
R5 — 470-ohm (10 pcs)
R6 — 100-kilohm (10 pcs)
R8-R13 — 10-ohm
VR1-VR10 — 22-kilohm log. potentiometer

Capacitors:
C1, C18-C21 — 0.22μF polyester
C2, C3 — 220pF styroflex
C4-C7 — See Table II
C8-C13 — 0.1μF disc
C14, C15, C22, C23 — 10μF, 25V electrolytic
C16, C17 — 2200μF, 35V electrolytic

Miscellaneous:
X1 — 18V-0-18V, 250 mA secondary transformer
S1 — DPDT toggle switch
— PCB, enclosure, 3-core shielded wire, plastic spacers, screws, nuts, mains lead, aluminium knobs, flexible wires etc.

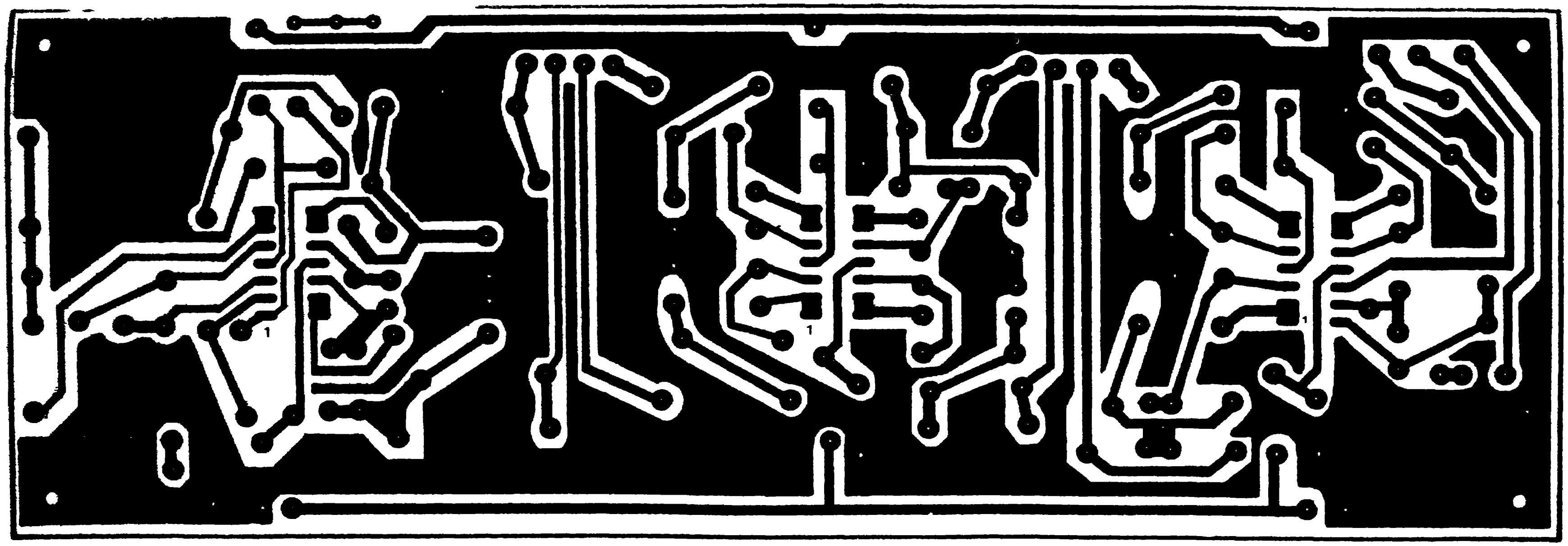


Fig. 5: Actual size PCB layout for the main circuit

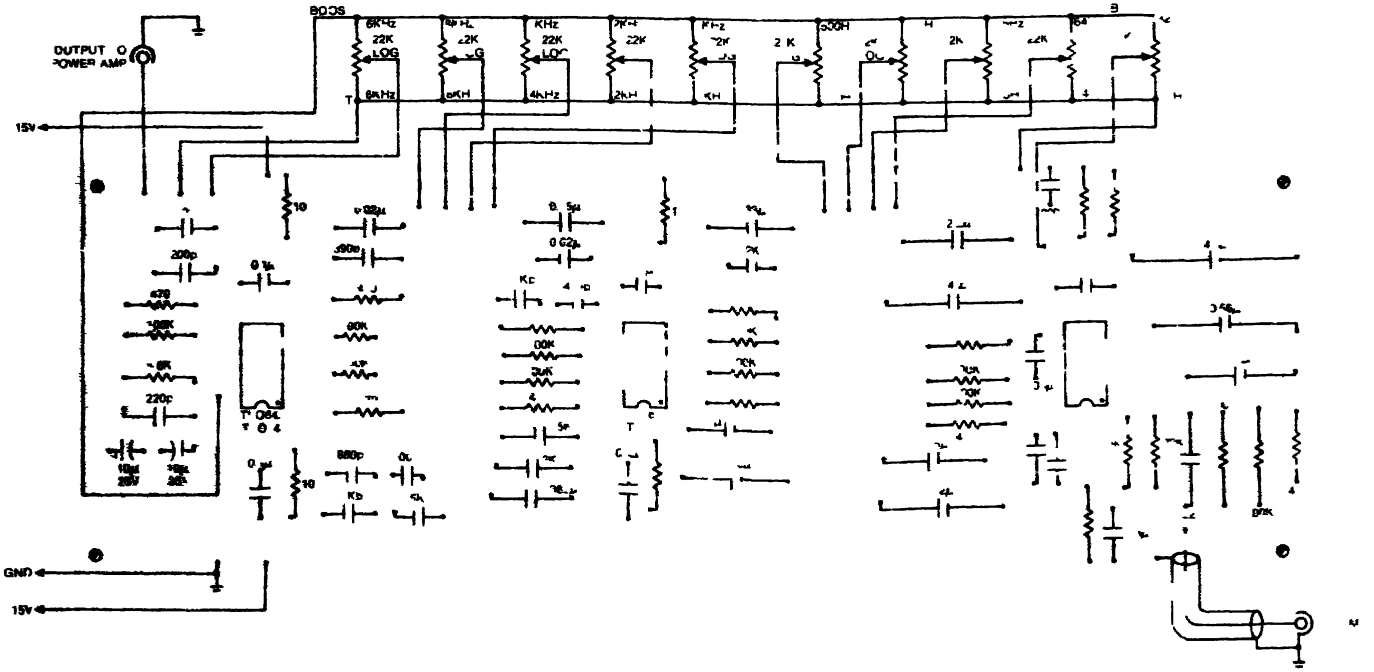


Fig. 6: Component layout for the main circuit

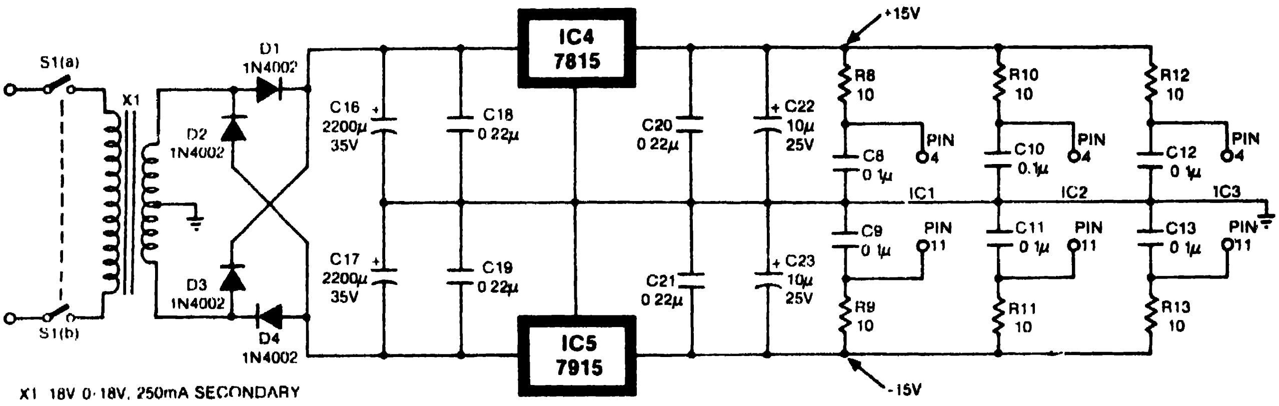


Fig. 7: Circuit diagram of power supply.

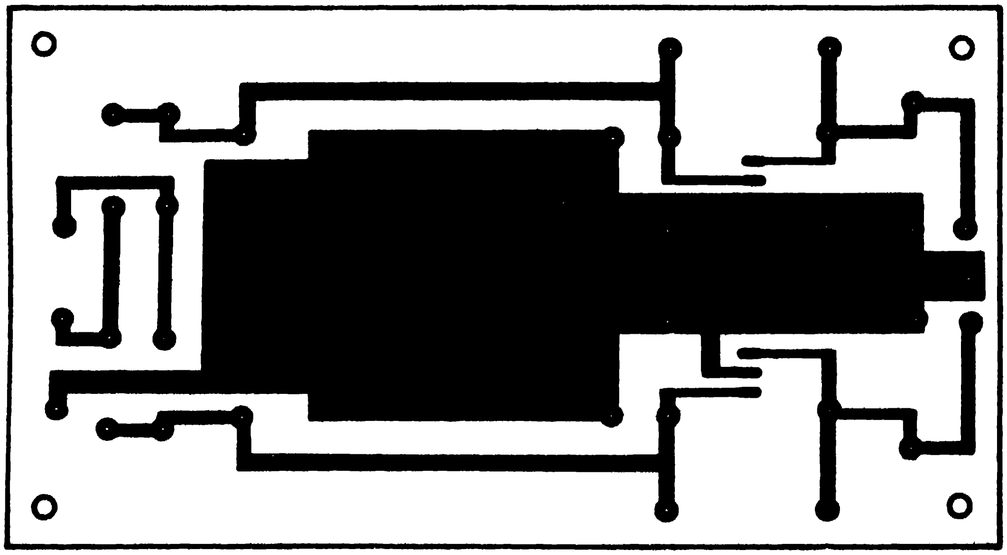


Fig. 8: Actual size PCB layout for power supply.

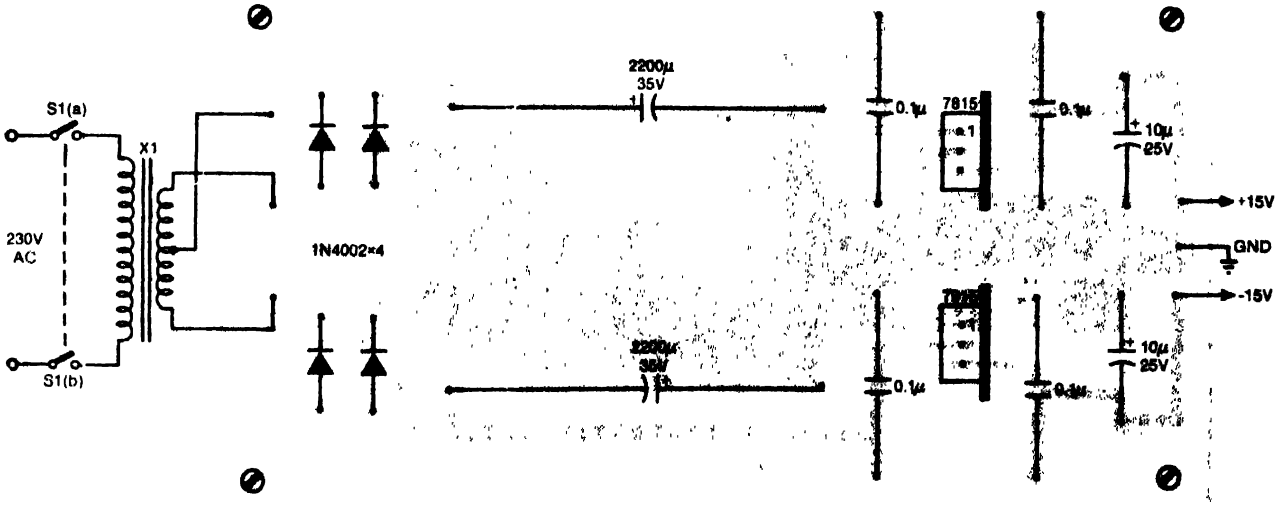


Fig. 9: Components layout for the PCB.

correctly. Then check whether you have connected the common point of all the controls, on the 'cut' side to the non-inverting input of A12 (see Fig. 6). This connection is very important.

Do not solder any controls first. Connect just the common point as mentioned above. Do not insert IC2. Switch on the power supply and check whether any of the ICs are heating up. They should just be warm.

Now connect the output to an amplifier. (If you have a volume control keep it at a low level.) Connect some source to the input of this equaliser. You should be able to hear the sound after the power amplifier.

Check the AC voltages, with an AC millivoltmeter, at pins 3 and 1 of IC1 with respect to ground. The voltage at pin 1 should be approximately five times the voltage at pin 3. If this is so, connect all the controls and then switch on again and connect a source. All the controls should work perfectly.

If any control is ineffective, look for bad soldering of the capacitors. Of course, IC2 must be inserted after all the controls are connected.

These are some simple tests you should perform before you fix up everything into a good stereo system.

□

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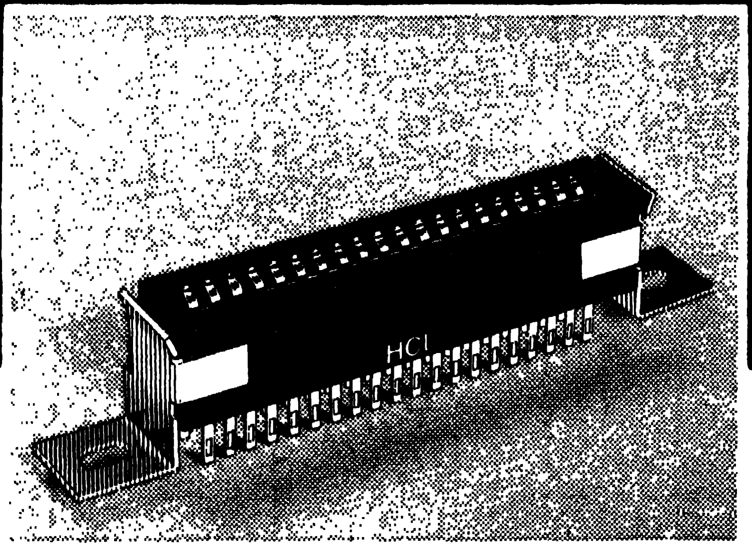

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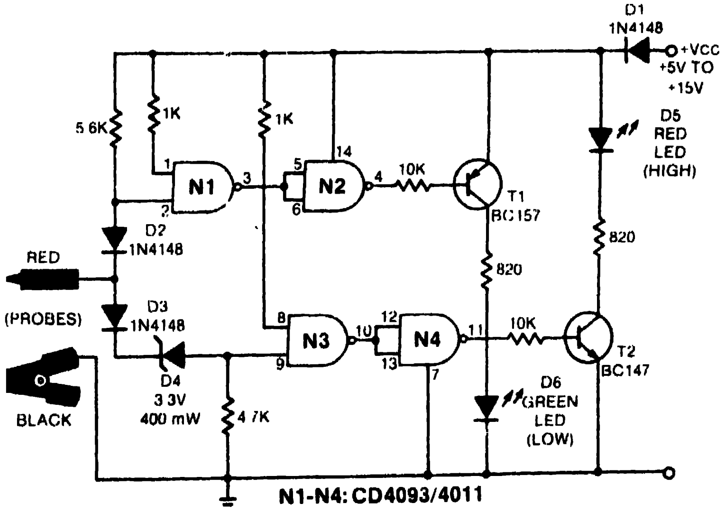
Simple Logic Probe

EFY has published quite a few logic probe circuits during the last few years. But here is a simple one providing four 'state' indications. It also has the advantage of reverse power supply polarity protection with a very low power consumption, say 40 mA only at +5V supply.

The four logic states indicated by the probe are:

1. **Floating**. When the probe is given supply (which may be derived from the circuit under test) and the probe is placed on the same point which is 'open' or 'floating' then both the LEDs remain off.
2. **Low**. Level '0' or 'ground' is indicated by the green LED which glows when the probe is either at the ground level or at logical '0' level.
3. **High**. This is indicated by glowing of the red LED when the probe is at a logical '1' level or at Vcc potential.
4. **Clock**. Clock pulses of any frequency can be indicated by glowing of both the LEDs simultaneously if the frequency is higher than 25 Hz, or glowing of one after the other at a lower frequency.



This circuit is protected against reverse supply by diode D1.

This versatile probe can be used for testing TTL or CMOS circuits since its voltage range is from 5V to 15V. The maximum current consumption of this circuit at 15 volts is 40 mA.

The circuit can be housed in the body of a wide pen or in a plastic tubing, with two wires coming out for supply, and tip of the pen serving as the tip of the probe itself.

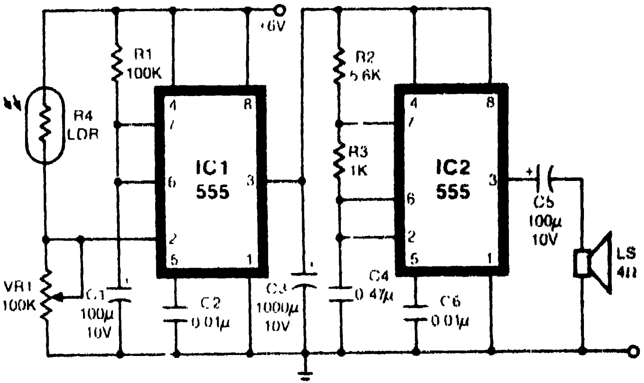
The LEDs can be fitted either on top of the pen or on its cylindrical surface.

D.C. UDESHI

Self Resetting LDR Alarm

The circuit uses two ICs, namely 555 timers. The first one is used in monostable mode while the second IC is used as an audio oscillator, i.e. in astable mode.

When the beam of light is focussed on LDR, its resistance remains low and the trigger terminal (pin 2) of IC1 is held at positive potential and its output is zero. Whenever the beam is interrupted, the resistance of LDR goes high. During that moment a negative pulse is applied to the trigger terminal and IC1 performs a 10-second monostable operation. The output of IC1 gets applied to the audio oscillator consisting of IC2 which gives an alarm for ten to eleven seconds.



The time period of the operation can be changed by varying the values of R1 and C1. The time period of operation is

$$T = 1.1\ R1\ C1$$

The frequency of audio oscillator IC2 can be changed by varying the values of R3 and C4. The frequency of oscillations is given by

$$f = \frac{1.44}{(R2+2R3)C4}$$

Sensitivity of the alarm can be adjusted by setting 100k potentiometer VR1.

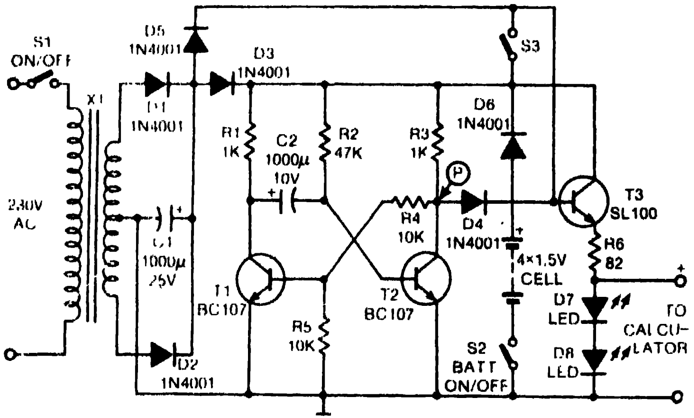
B. SRINIVASA RAO

Back-up Supply for Calculators

Many people use mains-adapters to drive their low wattage LCD calculators. But the problem they often face is due to sudden power failure, which 'clears' the calculator memory as well as the display digits.

Here's circuit to overcome the problem. If you take the calculator input from this circuit's output, the moment the power goes off, the battery (of 6V) will supply the power for a predetermined period. (In this circuit the period is set approximately to 40 seconds.) One can increase or decrease the period with suitable modifications in the values of R2 and C2. After this period the circuit's output will be nil.

If you wish, by closing S3, you can use the calculator as long as you like. It's advisable to open the switch S2 after using the unit, to avoid unnecessary battery current drainage.



X1 9V-0 9V, 250 mA SECONDARY

Here the two LEDs, D7 and D8, do two important jobs. They stabilise the output at 3 volts, irrespective of any input voltage or load variations. Their combination acts just like a zener diode of 3V breakdown voltage. Moreover, D7 and D8 act like visual indicators. When the mains power goes off, the brightness of the glowing LEDs reduces which helps the user to perform his job quickly.

Transistors T1 and T2 form a monostable multivibrator which gets triggered automatically when the power goes off. Even after the power failure, voltage Vp at point P remains nearly 5 volts for a period of 30 seconds.

Diode D1 is used to suppress unnecessary battery consumption. Transistor T3 acts like a buffer at the output section.

It has been observed that the calculators (of 3 volts) having current consumption up to 5.5 mA can be freely driven by the unit. One can modify the output section to use the same circuit for home computer power supplies.

SUBIR KUMAR BISWAS

A Novel Tank Level Controller

A 10-kilohm potentiometer is used here as the sensing element. A light rod, with a hollow ball at one end, is rigidly connected to spindle of the potentiometer. When water level changes, the potentiometer starts turning (see Fig. 1). The maximum rotation obtainable here is 90 degrees which is one third of the total possible rotation of a volume control. The control circuit is given in Fig. 2. The two transistors and resistors are connected to form a schmitt trigger multivibrator circuit whose transfer characteristics (V_{B1} vs V_{C2}) have two threshold voltage levels as shown in Fig. 3.

When input voltage V_{B1} exceeds 2.7 volts, transistor T1 goes into conduction, while T2 becomes non-conducting

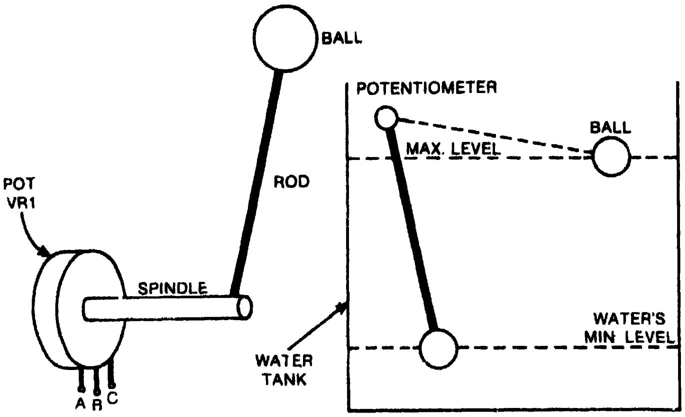


Fig. 1:

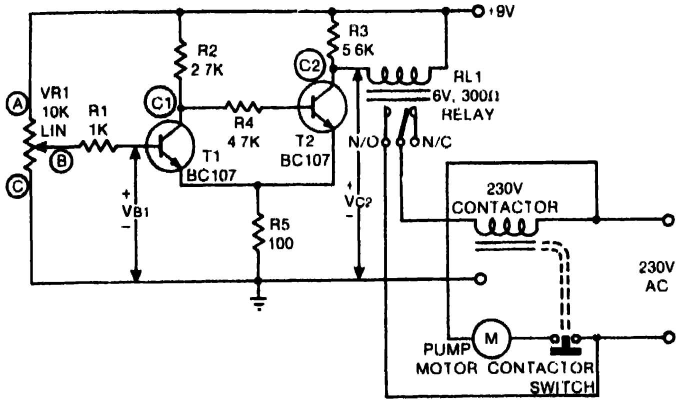


Fig. 2:

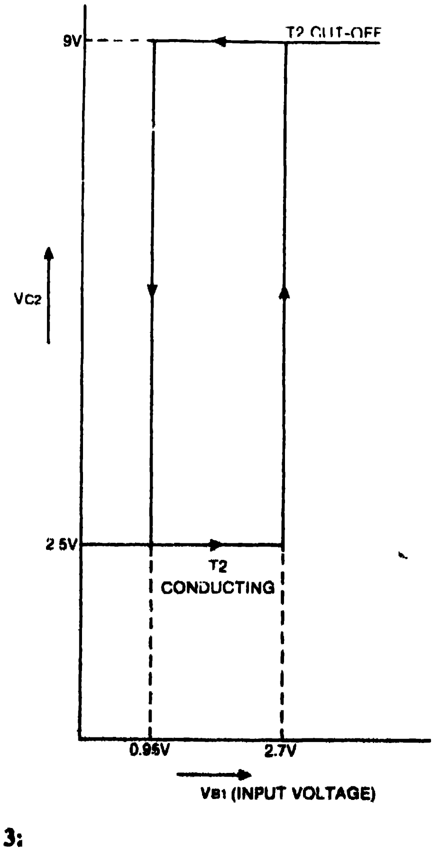


Fig. 3:

(cut-off) T2 remains in cut-off state until the input voltage becomes less than 0 97 volt When input voltage V_{B1} is less than 0.97 volt, T1 is cut-off and T2 goes into conduction, and the relay gets energised T2 remains in the conducting state, until V_{B1} exceeds 2 7 volts

The potentiometer is placed such that when the water level rises, V_{B1} also increases When the water level goes down to the minimum position or below, voltage V_{B1} goes below 0 97 volt and the relay gets energised As the contactor gets energised, the motor driving the pump is switched on This state continues until voltage V_{B1} increases to 2 7V (corresponding to maximum water level)

When the water level is above the maximum level (i e $V_{B1} > 2$ 7 volts), relay is de-energised and hence the motor is switched off This state continues until the water level has dropped below the minimum level (i e $V_{B1} < 0$ 97 volt)

The level (max level) can be raised by connecting additional resistors, (greater than 0 5k) between C2 and positive terminal of the battery And the minimum level can be adjusted by connecting resistors greater than 1k between C1 and positive terminal of the battery Rod length can be selected to suit the maximum and minimum levels required and the dimensions of the tank

The potentiometer is fixed such that in the minimum position it gives about 0 95 volt at the base of T1 Resistor R5 can be varied in value from 85 to 110 ohms for further adjustments

If the relay resistance is greater than 300 ohms, either the value of R5 can be increased or additional resistors can be connected in parallel with the relay

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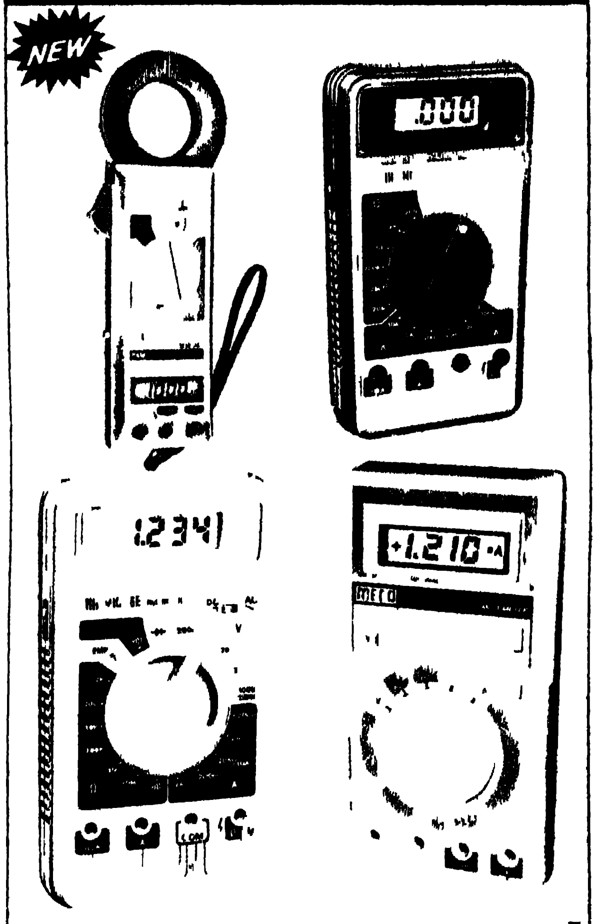

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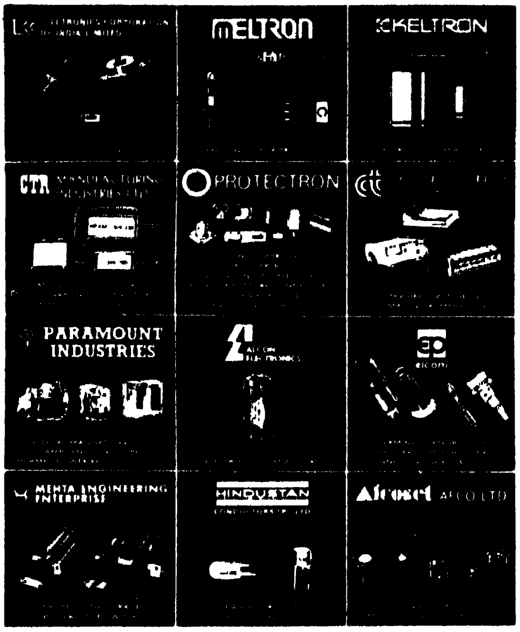

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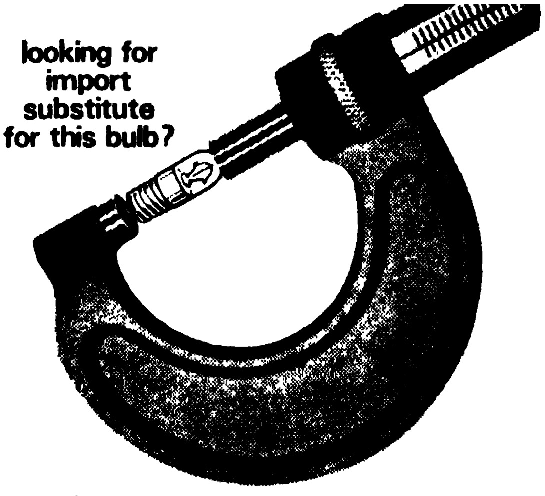
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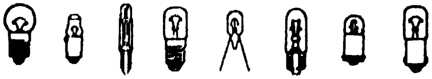

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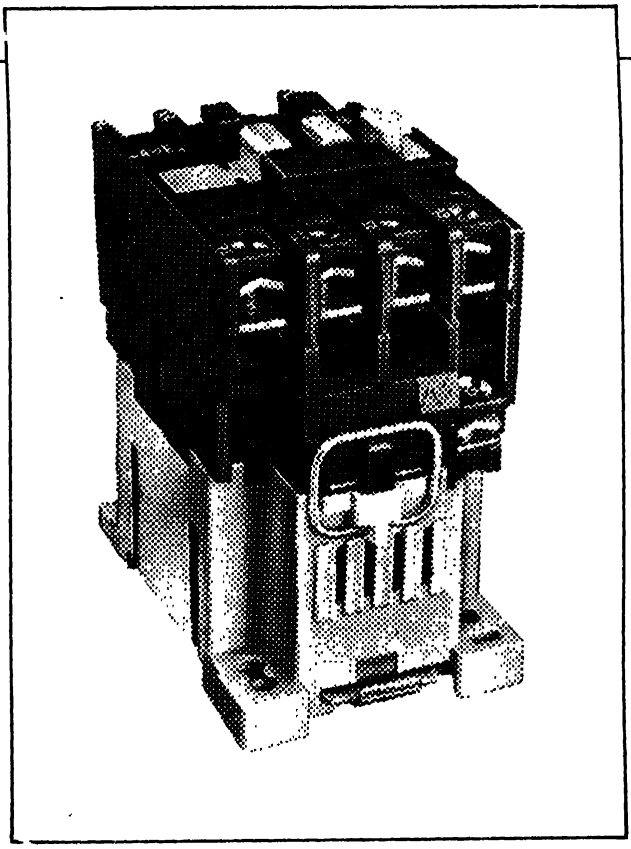Lakshmi Control Relays – CS 3 offer unmatched flexibility and versatility

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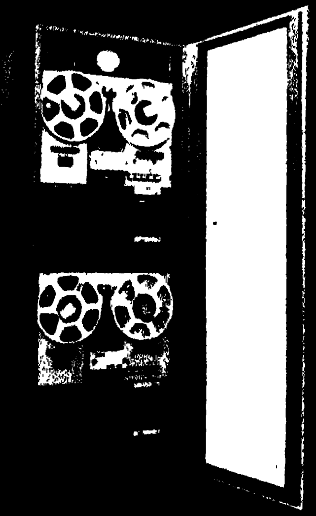

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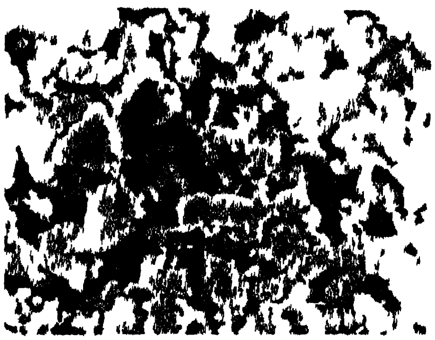

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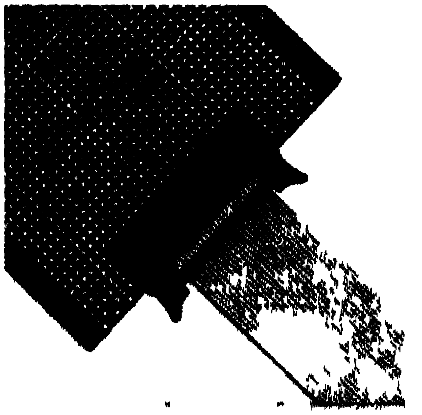

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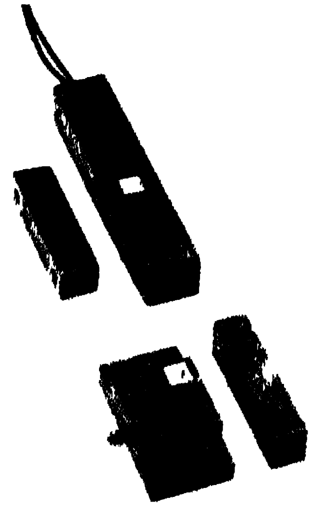

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LIQUID LEVEL CONTROLLER

Hemilton Switchgears HS Mark 7 Automatic Liquid level Controller is meant for automatic emptying (or filling) operations in drains storage tanks etc

It works on the principle of conduction of liquids Prods are positioned at two levels in the tank—higher and lower When the liquid reaches the higher level prod, the relay energises

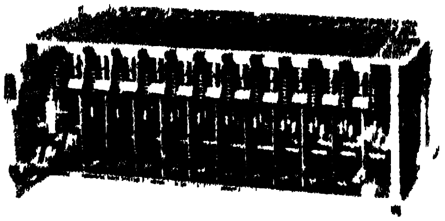
Control is precise for any distance between the high and low electrodes The unit can be mounted at any distance from the tank The controller can be used directly with small motors

LIQUID LEVEL CONTROLLER

Contact Hemilton Switchgears Chamber 315 (III Floor) 4/1 D B Gupta Road (Near New Bank of India) Pahar Ganj New Delhi 110055

MODULE GUIDES

Electrols introduces Metal Module Guides with 19mm pitch for PCBs of 130 and 160mm lengths Suitable spacers for PCBs with widths of 80 90 and 100mm are available with necessary mounting hardware The module bin can be supplied from 5-way to 20-way with suitable insertion for mother boards with sockets mounted with matching pitch of 19 mm Module guides are made of CRCA sheets of 20 guage The module bins can be stacked one on top of the other with suitable hardware

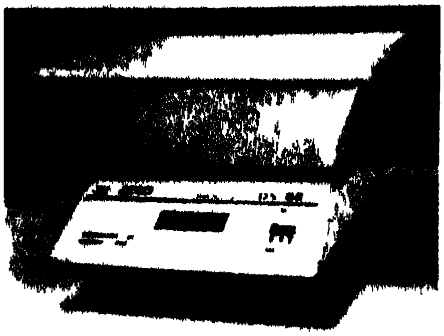


MODULE GUIDES

Contact Electrols, A27-28 Royal Industrial Estate, Naigaum Cross Road, Bombay 400031

WEIGHING SCALE

ATCO's Precision Weighing Scale is based on a strain guage load cell The scale s capacity is



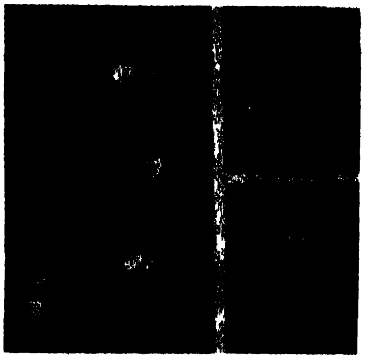
WEIGHING SCALE

1999 gms and reportedly gives perfect reading up to ±1 gm graduation A sleek looking gadget with LCD display it can be used in an office kitchen laboratory or postal departments and to weigh electronic components before packing

Contact Anant Trading Corporation 104 Creative Industrial Centre 72 N M Joshi Marg Bombay 400011

FLAT RIBBON CABLE CLIPS

SEE has recently introduced Flat Ribbon Cable Clips to mount any size of flat ribbon cable manufactured from non-conductive non-corrosive especially formulated thermoplastic These pressure-sensitive, adhesive-backed or screw-mounted clips securely hold flat or ribbon cables Cable can be removed for rerouting or replacement if desired Wide flexibility in design and application is available with these rugged space saving clips They can be used with any width flat cable and can accommodate stacked cables

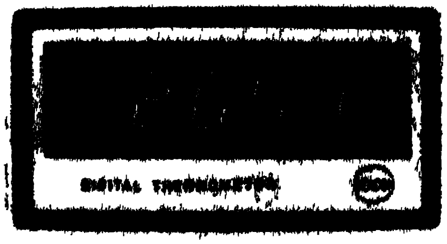


FLAT RIBBON CABLE CLIPS

Contact Suresh Electrics & Electronics Post Box No 9141 Calcutta 700016

DIGITAL THERMOMETER

Beacon's Digital Thermometer Model DTI-48 is a sleek low-cost, panel mounting instrument housed in ABS plastic case It is based on CMOS ICs The three LEDs of 12 5mm height provide a resolution of 1°C over the range of -100°C to +500°C Nonlinearity of platinum RTD is fully compensated in the instrument It has a built-in open circuit protection and lead wire compensation is provided by 3-wire system For temperatures below zero a negative sign appears to indicate polarity The instrument works on 5V DC supply 230V AC mains option is also available



DIGITAL THERMOMETER

Contact Beacon Industrial Electronics Pvt Ltd, 13-A Shri Ram Industrial Estate Katrak Road, Wadala Bombay 400031

KEY LOCK SWITCH

Elcom has recently introduced a new chrome-plated Key Lock Switch type KLS-5 It provides added safety to electrical and electronic equipments and prevents unauthorised use The design is low profile and has less than 6mm projection on the front panel very low contact resistance of less than 20 milliohms and an insulation resistance of minimum 100 megaohms

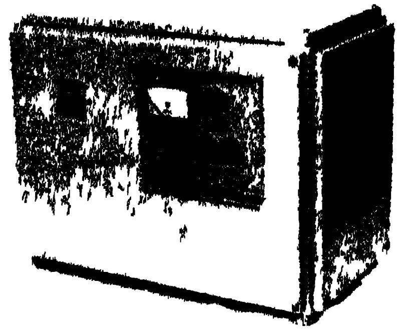
KEY LOCK SWITCH

Some typical applications are electrical cash registers points of sales terminals, computers, office automation machines programmable controllers and many other equipments It is rated for 125V AC/5A and 250V AC/3A

Contact Elcom, 103 Jaygopal Industrial Estate, B Parulekar Marg, Dadar, Bombay 400028

SERVO-CONTROLLED SOLIDSTATE STABILISER

Gelco's Servo-Controlled Stabiliser is designed to give accurate constant output using solidstate semiconductor switch instead of electromagnetic relay, which will give one per cent accuracy No waveform distortion fairly fast correction rate (35V/sec) no radio frequency interference, plug-in type control cord completely solidstate circuit for control of servo motor and over-load trip facility are the main features of the controller



SERVO CONTROLLED SOLIDSTATE STABILISER

It is available in single and three phase up to 200 kVA Ammeter and voltmeter are provided for monitoring current/voltage Also a toggle switch is provided for auto/manual operation

Contact MRK Brothers Engineers 310-A Commerce House Nagindas Master Road Fort Bombay 400023

ULTRASONIC LEVEL MONITOR

Oriole's Ultrasonic Level Monitor 2600 series is a non-contact measuring system used to continuously monitor the level of solids slurries, powders granules and liquids It is useful in metals and minerals mining coal-fired power plants, pulp and paper mills cement plants, chemical and processing industries, etc It offers a wide range of alarm sequences signalling facilities and auxiliary outputs, and can also be tailored to meet various industrial demands

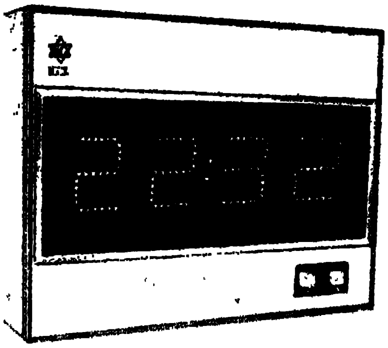
ULTRASONIC LEVEL MONITOR

Contact Oriole Services & Consultants Pvt Ltd, Post Box No 9275, 4 Kurla Indl Estate, Ghatkopar, Bombay 400086

ELECTRONIC DIGITAL CLOCK

DIC introduces an Electronic Clock system using digital display for accurate time with long distance (about 23m) visibility The system is highly reliable and economical

As it has no mechanical parts, there is no possibility for anything to go wrong to give incorrect time or frequent maintenance The



ELECTRONIC DIGITAL CLOCK

latest IC technology and highly reliable crystal controlled time base enable the clock for low power consumption and accurate time system. Time is displayed using seven-segment bright LED lamps. These are available with different sizes of displays varying from 1.27 cm to 10.16 cm.
Contact: Digital Instruments Corporation, N.B. Chamber, Opp. Canara Bank, Saijpur Bogha, Ahmedabad 382345.

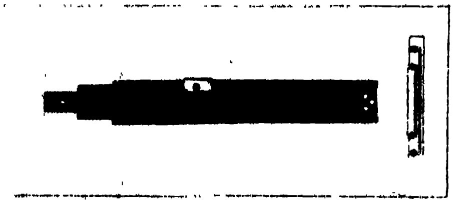
ELECTRONIC IGNITION SYSTEM

Electronic Ignition System from Advance Electronics is a compact unit which saves petrol when combustion efficiency is poor, the full fuel mixture may not be burnt by an inefficient spark, wasting some energy which exits with the exhaust and also settles as carbon in the engine, damaging it considerably.

The unit extends the life cycles of the battery, spark plugs and engine. In the prevailing system, 4 amperes of electricity have to be supplied by the battery, while the electronic system needs only 1 ampere for sparking and keeping break points clean. It keeps the spark plugs from getting fouled by carbon or oil deposits, which reduce the power of the spark. The improved combustion efficiency in the cylinders results in reduced carbon deposits on the cylinder surface, piston and block, burning the petrol completely.
Contact: Advance Electronics, Room 7A, 3rd Floor East Wing, Mercantile Buildings, 9/12 Lal Bazar Street, Calcutta.

TELESCOPIC SLIDE

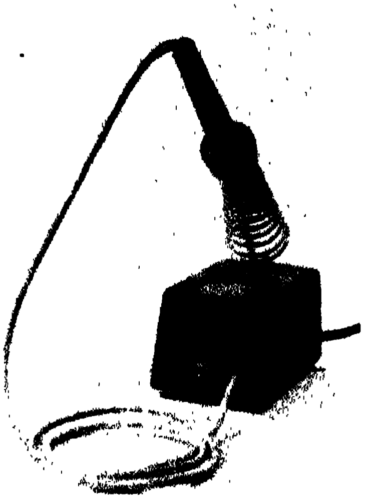
President Systems has introduced a new family of Telescopic Slides. These are full extension slides with ball-bearings made from three precision aluminium profiles with grooves for the ball-bearing travel. The grooves are machined to obtain the required precision which ensures that the rolling action of the balls is maintained throughout the lifetime of the slides. The use of lightweight aluminium ensures against corrosion problems common to steel slides used in hostile environments. These slides are rated for loads of 75 kg at full extension. These are particularly useful for unit assemblies such as disc drives, tape drives and circuit breakers. The slides are available in lengths of 45.7 cm, 53.3 cm and 61 cm.
Contact: President Marketing & Consultancy Services, Post Box 9495, Andheri East, Bombay 400093.



TELESCOPIC SLIDE

SOLDERING IRON

Headway Research Electronics offers a compact, reliable, efficient and easy-to-use 24V/50W Soldering Iron with easily interchangeable soldering tip. The automatic control of the temperature at a fixed point is achieved by switching the power 'on' and 'off' when a physical property of the sensing material changes reversibly at the temperature of control, with a minimum of drift or creep of the set point. The mass of the tip and the sensor dimensions/location are so chosen as to minimise temperature differential between sensor and the working tip. The heat module is made of stainless steel and has a low radiation loss. The power unit consists of 230V/24V double wound transformer, power-on switch, fuse, indicating lamps and an output socket for the soldering iron.

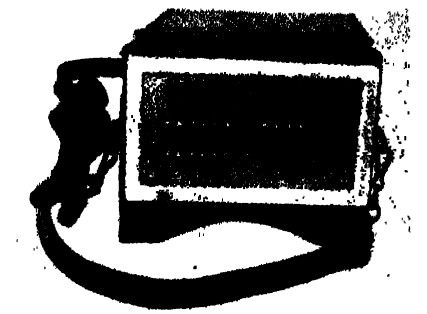


SOLDERING IRON

A few advantages over the conventional uncontrolled irons are: fast initial heating; fast recovery; lower power consumption; longer tip life and everlasting heating element, thus minimising the recurring expenditures.
Contact: Headway Research Electronics, D-21 Industrial Estate, Varanasi 221106.

MICROPROCESSOR BASED DC CALIBRATOR

Masibus has developed a highly reliable, versatile and precise Microprocessor Based DC Calibrator 'Unical 3001', capable of measuring and calibrating process signals (instrumentation), with the most stringent accuracy demanded by the industry. At the heart of the instrument is an 8-bit (8085) processor, 0.01 per cent fast sampling A/D converter and indigenously developed dedicated software. Its software controlled autocalibration loop within the measurement cycle ensures zero short-term and negligible long-term drifts.

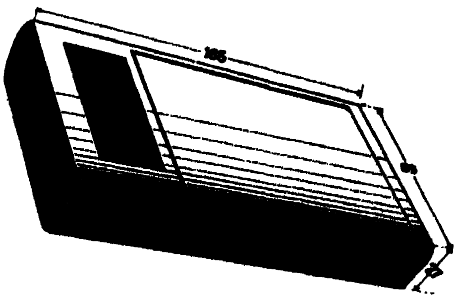


MICROPROCESSOR BASED DC CALIBRATOR

Its salient features include: measuring the output of or simulating thermocouple types B, E, J, K, R, S and T (ANSI standard), Pt-100 RTD; automatic cold junction compensation by means of simulated electronic ice point reference and 100 per cent digital linearisation eliminates use of conversion tables and thermometers; digital nulling facility for offset cancellation and differential measurement; mains-cum-rechargeable battery operated with built-in boost/trickle charger, battery low indication, and facility to display ambient temperature.
Contact: Masibus Electronics, L-128 GIDC Estate, Odhav, Ahmedabad 382415.

PLASTIC MOULDED INSTRUMENT CASE

Component Technique offers a Plastic Moulded Instrument Case suitable for handheld instruments with overall dimensions of 16.5cm (L) × 8.5cm (B) × 2.8cm (H). The bezel in front is suitable for four-digit display. A PCB of 8.0 cm × 7.5 cm can be fixed on the four projected lugs provided on the inside of the front cover by means of self-tapping screws. It features a separate battery compartment for 9V flat cell so that the cell can be replaced without opening the instrument. The 0.05cm deep recess provided on the front cover accepts an aluminium label of 11.1 cm × 7.1 cm for various control indications. Two antislip rubbers at the back preserve the case from scratches.
Contact: Component Technique, 8 Orion Apartments, 29/A Lallubhai Park Road, Andheri (W), Bombay 400058.



PLASTIC MOULDED INSTRUMENT CASE

ULTRA-VIOLET LIGHT SOURCE

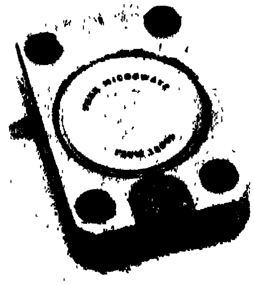
Poona Udyog has developed a low-cost Ultra-Violet Light Source useful for earsing UV EPROMs. It has the capability of erasing 15 EPROMs simultaneously with 2537 Å light in the short wave spectrum Direct exposure to light being harmful to eyes and skin, full care has been taken to prevent any exposure and has a micro-switch protection.

It also has a built-in 0-60 minute continuously adjustable timer which switches off the UV lamp after set time It operates on 230V AC requiring 20 watts maximum

Contact Poona Udyog, 72/3 'S' Block, MIDC Bhosari, Pune 411026

DROP-IN ISOLATOR

Trak introduces a Drop-In Isolator, with dimensions 1 8 cm × 1.2 cm × 0.37 cm. The isolator is easy to mount and is magnetically shielded and capable of being supplied to high rel specifications. The specifications are guaranteed from -54°C to +95°C In currently C-Band versions offered isolation is 20 dB minimum, insertion loss is 0 5 dB maximum, VSWR is 1.25 maximum and weight is 25 grams nominal.

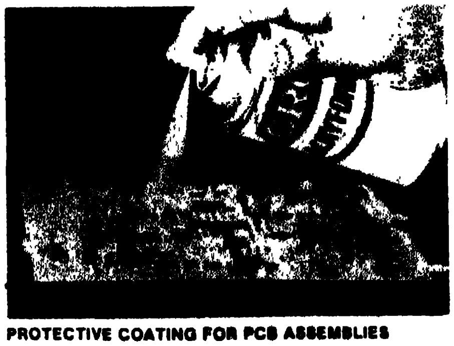


DROP-IN ISOLATOR

Contact: Chithra International, 1010/C 2nd Stage, Indira Nagar, Bangalore 560038.

PROTECTIVE COATING FOR PCB ASSEMBLIES

CRC Acryform, manufactured under a technical licence agreement with CRC Chemicals, Europe, is a fast drying, single component Conformal Coating for application on printed circuit assemblies. Having very good solderability and excellent flexibility CRC Acryform protects assembled PCBs from humidity, fungus and corrosion It is easy to apply, has two years long shelf life, and is easy to remove if rework becomes necessary It has air drying time of 20 minutes. As CRC Acryform is transparent, coated components are easily identified



PROTECTIVE COATING FOR PCB ASSEMBLIES

Contact. Danmet Chemicals Pvt Ltd, Electric Mansion, 6th Floor, Appasaheb Marathe Marg, Prabhadevi, Bombay 400025.

PORTABLE DIGITAL TACHOMETER

Chauvin Arnoux, France offers Portable Digital Tachometer. Contactless RPM measure ment is done on any rotating part with a photoelectric sensor and with an ammeter sensor on two or four stroke engines.

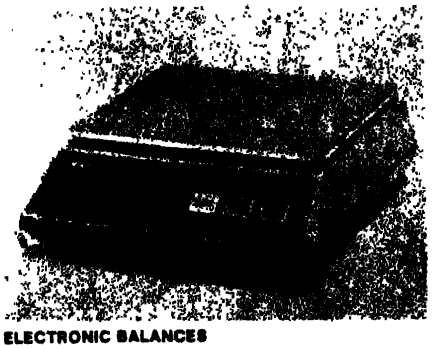
It has 10,000 measuring counts and two measuring ranges 10,000 RPM and 100,000 RPM with automatic selection of the appropriate measuring range with accuracy of ±2 points. Response time at 10^{-3} without range change is two seconds and with range change three seconds. Memorising time is to the extent of the battery lifetime of 100 hours. The sensors are interchangeable without any internal modification and are connected via a seven-point female connector. The weight of the instrument is 450 gms.

PORTABLE DIGITAL TACHOMETER

Contact: Symbiotic Electronics, 11-6-184 Public Garden Road, Hyderabad 500001.

ELECTRONIC BALANCES

A & D Company Ltd, Japan has introduced a new series of compact Electronic Balances EW-A/B, in capacities and resolutions of 60g × 20mg, 300g × 100mg, 600g × 200mg and 3000g × 1g. Every unit converts from grams to ounces and vice versa at the touch of a button. These balances are light enough to be easily carried anywhere.



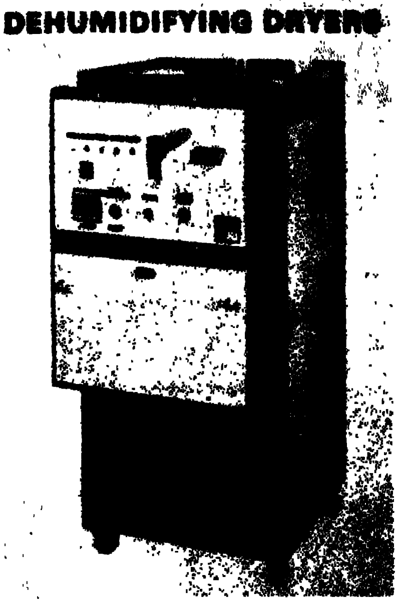
ELECTRONIC BALANCES

The EW-A balances are built for AC operation while the EW-B balances have a built-in rechargeable battery that permits them to operate continuously for up to 8 hours independent of outside power sources for even greater portability

Contact. Universal Biochemicals, Enzyme House, 6 Sathya Sayee Nagar, Madurai 625003.

PLASTIC DRYERS

Bry Air's Plastic Dryers for hygroscopic resins and plastic moulders provide a constant -40°F dewpoint (or lower) year round, even under extreme ambient airconditions. It efficiently drys the most demanding thermoplastic materials such as ABS, acrylic, nylon, PVC, polyurethane, PBT, SAN, polysulfone etc.



PLASTIC DRYERS

It has a rotating bed module divided into four separate bed quadrants. Two quadrants dry the process air, while the other two are being reactivated and cooled. The solidstate temperature control enables precise control of process air temperature and displays digital readings of process return and reactivation temperature. The energy efficient dryer models are available from 50 to 500 cfm.

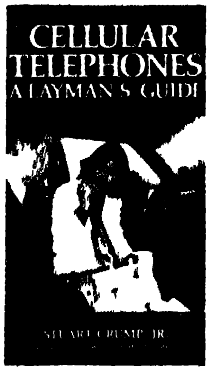
Contact: Arctic India Sales, 20 Rajpur Road, Delhi 110054.

SOLDERS/ALLOYS

Indium Corporation of America, USA offers Solders/Alloys for electronics, communication, semiconductor, computer industries. It also offers ingot, rod, wire, ribbon, paste, cream, preforms, pellets, shot etc for melting points from 10.6°C to 1063°C.

Contact: FHM International, 208 Pal Mohan House, Padam Singh Road, New Delhi 110005.

Book Reviews



Cellular Telephones:

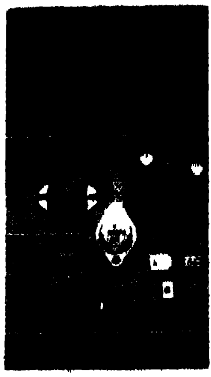
A Layman's Guide

By Stuart Crump Jr with an afterword by John Naisbitt; published by Tab Books Inc., USA; pages 160 (13 cm × 21 cm); soft cover; price: US $ 9.95.

The cellular radiotelephone is the new generation mobile phone system which is revolutionising person-to-person communications Effective portable telecommunications makes the cellular phone a necessary personal and business productivity tool

This layman's guide makes the executive familiar with the basics of cellular technology and practical usage Written in a lucid non-technical language, the book explains how to make an efficient use of a mobile phone, how to use it as an effective productivity tool and how to get the maximum status value out of a new car phone It contains a buyers' guide on the available cellular phone equipment and provides tips on mounting it in an automobile An interesting, well written book even for those who have no knowledge of electronics Unfortunately, it will find limited use in India

—R B

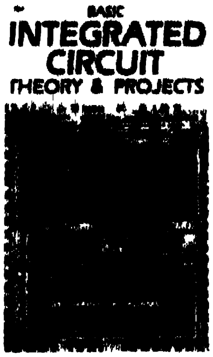


Basic Transistor Course: Second Edition

By Stan Gibilisco; published by Tab Books Inc., USA; pages 186 (13 cm × 21 cm); soft cover; price: US $ 13.50.

This book provides an excellent reference guide for the beginner in electronics or the student who needs a quick brush-up on the latest developments in solidstate technology Divided into ten chapters, the book begins with an explanation of the semiconductor device, how it works and its behaviour in the presence of other components. The fundamentals of the atomic theory and the differences between conductors, insulators and semiconductors are also discussed. Transistor characteristics and audio amplifiers are discussed in separate chapters. A complete chapter is devoted to the field-effect transistor in its myriad forms. The last chapter features practical circuits showing this component in a variety of situations including amplifier circuits, relay circuits and radio receiver circuits This updated and revised book provides a general background in the growing field of transistors

—R.B.



Basic Integrated Circuit Theory and Projects

By Charles K. Adams; published by Tab Books Inc., USA; pages 268 (13 cm × 21 cm); soft cover; price: US $ 11.95.

The integrated circuit has become such an intrinsic part of modern electronic technology that every hobbyist must have some basic knowledge about how it works and how it can be used This book explains transistor and IC theory in a simple and lucid language

Divided into eight chapters, the book first covers the theory and working of semiconductors Next, the fabrication of transistors and integrated circuits is discussed to give an insight into the various manufacturing processes required The functions of both analogue and digital ICs are discussed in detail and the specifications of the representative ICs are also covered

Chapters six and seven discuss the typical applications for both analogue and digital ICs The last chapter covers 23 projects using the integrated circuits that have been studied The theory is thus reinforced by useful IC projects ranging from a simple 5V regulator to a 555 timer free-running oscillator Step-by-step instructions for these projects are supported by complete schematics and circuit diagrams

The book will provide an ideal workbench guide for new hobbyists who do not have an advanced knowledge of electronics

—R B

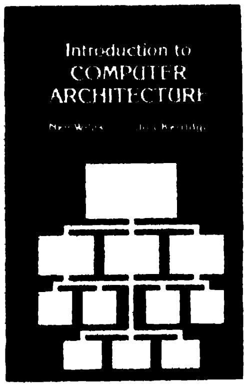
The Transducer Project Book

By Michael J. Andrews; published by Tab Books Inc., USA; pages 140 (13 cm × 21 cm); soft cover; price: US $ 8.95.

This book is not only a collection of sensor projects, it also provides a practical guide to learning more about transducers and transducer applications. The first three chapters contain some basic knowledge of electronics besides offering some suggestions for making electronic designing a bit easier. Chapter one introduces the world of transducers and their capabilities, while chapters two and three help the interested experimenter design basic amplifier and power supply circuits.

Chapters four to sixteen provide some varied and interesting projects. Each chapter gives enough information to build the project. Brief explanations of the circuits and design procedures are also provided wherever necessary. The projects described in the book include an electronic balance, a sound-activated switch, an automatic night light, a moisture detector, a seismic sensor, a tachometer, an experimental smoke alarm and a temperature survey meter. Each project is capable of being expanded into a more elaborate design. All projects clarify and reinforce knowledge of transducer technology while also providing the hobbyists with hours of experimenting.

—R.B.



Introduction to Computer Architecture

By Neil Willis and Jon Kerridge; published by A.H. Wheeler & Co. Pvt Ltd, Allahabad; pages 208 (16 cm × 24 cm); soft cover.

The book under review provides a clear, concise introduction to ideas and basic concepts of computer architecture rather than concentrate on one computer. Chapter one introduces all the basic concepts of computing systems including distributed systems. Chapters two and three provide information on basic peripherals and backing store devices respectively, while chapter eight concentrates on the transfer of information to and from peripheral devices. Chapter five includes an outline of the structure and requirements of machine code with a review of addressing techniques. Chapters four and six give functional description of memory together with implementing techniques and processing units including synchronous and asynchronous operation respectively. Chapter seven provides information on interrupts. Chapter nine further discusses the distributed systems in detail. Chapter ten describes architectural developments to increase processor throughput.

Two appendices are also provided in the book to describe representation of characters and fixed and floating point numbers, and a computer system simulator. It is an ideal introductory text for students of computer science.

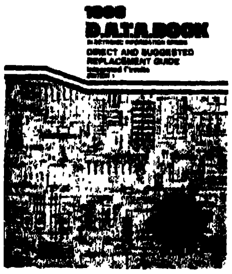
—R.G.

Master Guide to Service EC-TV Spectra Super (Colour TV)

By Desai & Desai; published by Jeevandeep Prakashan, Bombay; pages 52 (18.5 cm × 24.5 cm); soft cover; price: Rs 25.

In this book, service engineers and technicians in the field of colour TV servicing will find a lot of useful practical and theoretical information to service EC Spectra Super colour TV receiver. Various practical aspects like layout diagrams for modules fitted on the chassis and complete block and circuit diagrams for the receiver are discussed in detail. The book also explains voltage measurement at each stage, common faults of the circuit, the PAL decoder and chroma circuit signal waveforms, their functioning and servicing. The book contains enough information for a technician to service an EC spectra super receiver with confidence.

—S.D.G.



Direct and Suggested Replacement Guide—Integrated Circuits

Published by D.A.T.A. Books Inc., USA; available in India with Allied Publishers Subscription Agency, Madras; first edition (1986); pages 356 (22 cm × 28 cm); soft cover.

The book has been prepared specifically to facilitate design engineers, purchasing personnel, electronic maintenance engineers and other professionals throughout the electronics industry. It gives both direct replacement and suggested replacement information for digital, interface, microprocessor, audio/video, linear and memory ICs. While the information on replacement devices that have the same part number and specifications as the device it can replace is given under the Direct Replacement section, a list of more than 20,000 devices provided by over 40 major manufacturers is given in the Suggested Replacement section. One can simply look up a specific device by its part number and see the names of the manufacturers who make, or who have made, that particular device. The manufacturers' addresses, phones and telex numbers with their codes are also provided in this book.

—R.G.

ATTENTION

TELEVISION AND RADIO MANUFACTURERS

PERFECT ELECTRONICS PVT. LTD. MANUFACTURERS OF DEFLECTION COMPONENTS (DEFLECTION COIL, LINEARITY COIL, LINE DRIVER TRANSFORMER AND LINE OSCILLATOR COIL, ETC)

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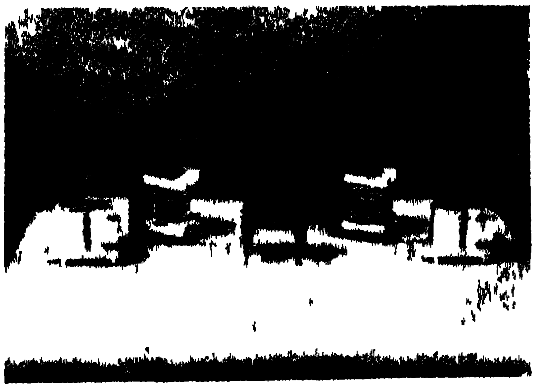

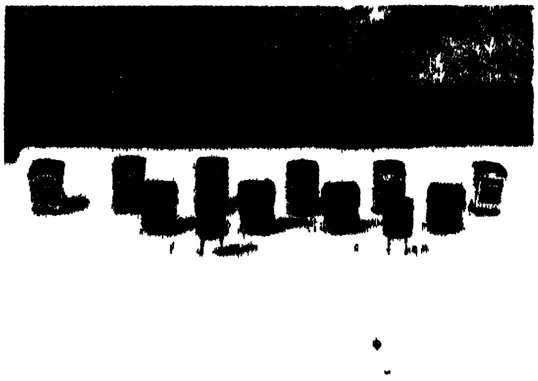

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MADRAS-600041

Company Profiles

Meltron forging ahead in computer development

The Computer Division of Maharashtra Electronics Corporation (Meltron) is humming with many new developments Meltron has ambitious plans to achieve rapid growth in the fields of marketing computers, software development and consultancy

Meltron has also recently entered into a joint venture with Tandon for the manufacture of 16-bit microcomputers for use in governmental and commercial organisations Associated with the world famous Tandon Associates, USA, Tandon is a leading manufacturer of disc drives This joint venture will shortly commence production of TM 6000 range of PC and PC-XT computers at a newly set up factory at Kudal

Meltron has also been appointed as primary consultants to the government of Maharashtra in keeping with the latter's drive to effectively utilise computers in its various departments The TM 6000 range soon to be launched commercially, not only provides a unique package in terms of price and performance, it can also be attached to a wide range of peripherals, making it suitable for a large number of applications ranging from commercial data processing to scientific and industrial applications Another highly innovative achievement is the 'Meltalk' which facilitates communication between two PCs and is extremely suitable for the Indian environment

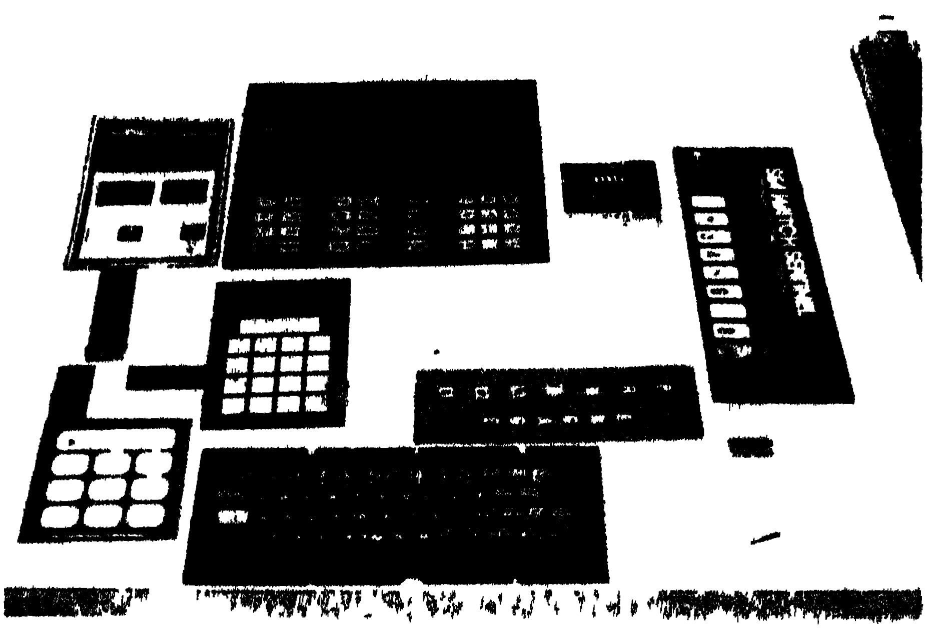
Meltron has participated very actively in the 'computer play school' project of the state government during its silver jubilee year Meltron has supplied computers to several schools in the state under this scheme which acquaints school children with the uses and applications of computers

Control-Touch Electronics to produce membrane switches

American Screentronics Inc. of Detroit, Michigan—one of the leading manufacturers of membrane switchboards in the USA—is transferring its technology to Control-Touch Electronics Pvt Ltd in Pune American Screentronics is headed by Mr Vijay Walvekar who is its president He has an extensive background in the manufacture and management of membrane switchboard producing plant

Switchboards manufactured at American Screentronics have a minimum life of five million cycles Switchboards made by Control-Touch Electronics will have the same life span

These switchboards will be backed by life-time free replacement warranty in case of malfunction or failure during normal operation Control-Touch Electronics is perhaps the first company in India to produce membrane switchboards, using state-of-the-art American technology, equipment and raw material



Membrane switches from Control-Touch Electronics

These membrane switchboards have many advantages over conventional switchboards They are most suitable in microprocessor based equipment, programmable logic controls, NC and CNC machines, medical and electronic equipment, household appliances, TV sets etc.

Control-Touch Electronics also has plans to start producing silicone keypads, beginning from [illegible]. Silicone keypads perform the same function as membrane switchboards

Import substitute computer components from Novoflex

Novoflex Cable Care Systems, a Calcutta-based manufacturer of electronic component parts and wiring accessories has developed various import substitute computer components for use in computers and allied equipments The product line includes cable ties, printed circuit board supports, self-adhesive adjustable cable clamps, flat ribbon cable clips, twist clips, etc The company has already started marketing and supplying these products to various computer and computer peripherals manufacturers

Novoflex is already in the process of developing many additional range of products and is shortly going to introduce push-mount wire holder to channel or route a group or bundle of wires, push-mount quick clip to lift off wires from neighbouring [illegible] without aid of any pin or rivet. All these parts are expected to reduce the costs by speeding assembly.

Salzer Electronics enters market

The Coimbatore-based Salzer Electronics Ltd entered the capital market with 500,000 equity shares of Rs 10 each for cash at par.

The company, which will be manufacturing cam-operated rotary switches with electronic tripping device of all ranges up to 250A from August, has entered into technical and financial collaboration with West German Samelzer Schaltgarate Fabrik KG and trial production for the high precision switches has already begun. The present demand for these switches is valued at Rs 35 million and, being an import substitute item, these switches enjoy governmental protection.

With the estimated cost of the project at about Rs 20 million, German collaborators will also be participating in the equity capital. Already orders worth Rs 5 million for these items have been booked by the company.

With no gestation period and an assured market, the low-cost high technology project will not be affected by power cuts.

Usha Micro set for growth

Usha Microprocess Controls Ltd has shown a good performance in its working results for 1985. The company's sales trebled from Rs 28.8 million in 1984 to Rs 64.8 million in 1985. The profit before tax increased by 321 per cent from Rs 2.610 million in 1984 to Rs 8.367 million in 1985. The company has declared a dividend of 20 per cent for the year ended December 31, 1985.

The company has recently acquired a letter of intent to set up a new factory at Surajpur (Dadri) in Uttar Pradesh to manufacture Rs 200 million worth of computer systems and modems. Besides, the company has also obtained government approval to enhance its production capacity at the existing factory to manufacture computers and microprocessor based systems worth Rs 200 million.

Usha Micro is promoting the concept of 'electronic office'. With this concept in mind, the company and its subsidiary Usha Computers and Peripherals Ltd has gone into the manufacture of a number of office automation equipment including EPABX, dot matrix and line printers, floppy drives and diskettes, electronic telexes and other telecom products and modems.

Lapiofic American project at SEEPZ

Lapiofic American Electronic Ltd, an Indo-US joint venture, is setting up a Rs 100-million export-oriented project at SEEPZ, Bombay. The company will manufacture epitaxial silicon wafers for the first time in the country in technical and financial collaboration with Lap International Ltd.

The US company, which is transferring the latest state-of-the-art technology on a one-time fee of Rs 500,000 has agreed to buy back at least 50 per cent of the total production of the SEEPZ plant for a period of three years at the ruling international prices. The plant in India will be manned by technical experts from the US company and Indian engineers trained at the collaborator's works. The US company has guaranteed a 40 per cent return on sales turnover.

The plant is expected to start trial runs in January 1987 and commercial production by June 1987. The Indian promoter, Mr H.S. Wahi, expects the plant to achieve 80 per cent capacity utilisation in the first year and its rated capacity in the second year. In 1990, the company plans to buy two additional reactors to double the plant's capacity at a cost of around Rs 2 million.

ECIL increases output

The Electronics Corporation of India Limited (ECIL), a public sector undertaking of the Department of Atomic Energy, has shown considerable increases in production, sales and profits during 1985-86.

The company recorded a turnover of Rs 1280 million in 1985-86 as against Rs 840 million last year. Production and sales registered an increase of over 50 per cent and profit before tax was Rs 102 million as against Rs 24 million last year.

In 1985-86, the company made important contributions to many projects of national importance by supplying control and instrumentation systems for the Narora atomic power project, the cement plants at Neemuch and Andur and to the HBJ pipeline project of Indian Oil Corporation. It also supplied turbine automation systems for Anakbori and Anapara thermal power plants and data acquisition systems to Raichur, Korba and Ramagundam thermal power plants.

ECIL also supplied computer systems to the Life Insurance Corporation of India, and computer-based data handling systems and air traffic controllers to the Indian air force. ECIL's antenna systems have been supplied to the defence services, Department of Telecommunications, ONGC, ISRO, NTPC and others.

Keonics to expand the Electronics City

The Karnataka State Electronics Development Corporation (Keonics) plans to double the size of its existing 310-acre Electronics City in view of the anticipated demand for land from a number of new projects which are coming up. Action has already been initiated for acquiring 29 acres and there are plans for acquiring another 300 acres adjoining the existing site.

About 85 per cent of the land available has been allotted for 38 medium- and large-scale projects in the last two years. The Indian Telephone Industries had been allotted over 60 acres for its second electronics switching systems plant for which the investment is expected to be around Rs 1000 million. Apart from this, some 30 acres had been reserved for small-scale units, and the Karnataka Small-Scale Industries Development Corporation (KSSIDC) was currently contructing three-storeyed buildings with 14 flats/sheds on each floor.

In order to accommodate new projects, Keonics has to expand the Electronics City, especially since the new investment in electronics projects was far in excess of the planned growth. During the Seventh Plan period, the present trends indicate an investment of around Rs 3500 million to Rs 4000 from an earlier estimate of Rs 2400 million.

Insat to supply materials

Insat International Semiconductors has been floated in Madras with the main object of supplying raw material and devices from abroad to the actual users at competitive prices. This has been achieved to some extent by adding minimum margin on the suppliers' prices. As the company procures the items in fairly large quantities, the price benefits are being passed to the customers.

The company also plans to go into the production of semiconductor devices with the same objective.

FOREIGN COLLABORATIONS

(Approved between January and March, 1986)

Name & Address of the Indian Film	*Name & Address of the Foreign Firm*	*Item of Manufacture (Nature of Collaboration)*
(1)	*(2)*	*(3)*
Orissa State Electronics Dev Corpn Ltd 289 Sahidnagar Bhubaneswar 750007	GTE ATEA Belgium	EPABX/EPAX and allied equipment (Technical)
B N Ojha C-20 Hauz Khas New Delhi 110016	MTX Telecom Services Inc Canada	Mine communication safety and indl electric equipment/systems (Financial)
Crompton Greaves Ltd 1 Dr V.B Gandhi Marg Bombay 400023	Siemens AG West Germany	Electronic telephone instruments (Technical)
NGEF Ltd Post Bag No 3876 Byappanahalli Post Bangalore 560038	AEG Telefunken AG West Germany	EHT transformers and other special transformers (Technical)
Tunertek India Pvt Ltd Raj Bagh Extension P.O. LIC, Srinagar (J & K)	AWK GmbH FRG	Electronic tuners (Technical)
Electro Scan India Ltd No 11 Ukkiyam, Torappakkam Madras 600096	Plessey SPA Italy	Line output transformers, switch mode transformers etc (Technical)
Instrumentation Ltd Jhalwar Road Kota 324005	Toshiba Corpn Japan	Digital control systems (Technical)
Koron Business Systems Ltd 28-30 Nahur Udyog Estate Opp Ralli Wolf, Mulund (West) Bombay 400080	Sharp Corpn Japan	Automatic plain paper copiers (Technical)
Wipro Information Technology Ltd S B. Towers 88 M.G Road Bangalore 560001	Epson Corpn Japan	Computer peripherals (Technical)
ASEA Ltd ASEA House, Sunderlal Bahl Path Bombay 400038	ASEA AB Sweden	Converters for speed control for motors (Technical)
Shyam Sunder, Shubha Griha Chedan Thottam Gnanambika Mills P O Coimbatore 641029	CAME Co. AB Sweden	Electronic digital pulse meters (Financial)
Bharat Electronics Ltd Jalahalli P.O. Bangalore 560013	Brown Boveri Switzerland	50kW short-wave broadcast transmitters (Designs and drawings)
Electronics Corpn of India Ltd Hyderabad 500762	BBC Brown Boveri & Co. Ltd Switzerland	500kW RF antenna selector switches (Designs and drawings)
Infocentre Pvt Ltd Plot No. A/10, Electronic Complex Kushaiguda Hyderabad 500762	Instagraphic Products Ltd UK	Printed circuit boards (Financial)
Multitech International Ltd 15-17 Industrial Estate, Dharuhera Haryana	British Telecommunications Plc UK	Microprocessor based video terminals with modems and printers etc (Technical)
Sandeep Engineers Pvt Ltd GF-1 Prabhat Kiran 17 Rajendra Place New Delhi 110008	Watson Technology Ltd UK	Minicomputer/microprocessor based systems (Financial)
Tata Burroughs Ltd Bombay House, Homi Modi Street Bombay 400023	Rodime Europe Ltd UK	Winchester disc drives (Technical)
Ajay Syscon Pvt Ltd 784 Deccan Gymkhana Opp Kamala Nehru Park Pune 411004	Syscon International Inc USA	Analytical instruments etc (Financial)
MCE Products Sales Service Pvt Ltd 37 Okhla Indl Estate New Delhi 110020	Carleton F Worfolk USA	Parabolic antennae feed horn, polariser amplifiers etc (Designs and drawings)
Soumag Electronics Ltd 11-3 Instronics Estate Madras 600041	Crouzet (SA) France	Microprocessor based ticketing machines (Technical)
W S Insulators of India Ltd Porur, Chengalpattu Distt Madras 602104	Siemens AG West Germany	Powerline carrier communication terminal equipment (Technical)
Gopal Krishna Kejriwal 82/2 Cooperganj Kanpur	Siemens AG West Germany	Electronic telephone instruments (Technical)
D K Khaitan S-323A Panchsheel Park New Delhi 110017	Industries FACE Standard SPA Italy	Telephone instruments and related components (Technical)
S.V Mohta Atma Ram House, 13th Floor New Delhi 110001	Metalvuoto Films SPA Italy	Metallised plastic films for capacitors (Financial)
Kerala Electrical & Allied Engg Co Ltd Panampally Nagar, Distt Ernakulam Cochin 682016	Honda Denki Japan	Nickel cadmium batteries (Technical)
Ashok Gupta Mini Commerce House 2-B Ganesh Chandra Avenue Calcutta 700013	Woo Yang Electronics Co. South Korea	Plastic film capacitors (Technical)
Norsk Data (India) Pvt Ltd Plot No. 47, Developed Plots for Electrical & Electronics Industries Seevaram Village, Perungudi Madras 600096	Norsk Data AS Norway	Minicomputer/microprocessor based systems (Financial)
Facit Asia Ltd Perungudi Madras 600096	Facit AB Sweden	Electronic typewriters in Hindi and Devanagari scripts (Technical)
Teltherm Instruments Pvt Ltd 63 R H. Road, Jammi Buildings Madras 600004	Action Instruments Co. Inc. UK	Electronic signal condition modulars (Designs and drawings)
Narendra Kumar Patnni 42-A Jolly Maker Apartment-I Cuffe Parade, Colaba Bombay 400005	Data General Corpn USA	Minicomputer/microprocessor based systems (Financial)
Best & Crompton Engg Ltd 29 Rajaji Salai Madras 600001	Time Office Computers Proprietory Ltd Australia	Minicomputer/microprocessor based systems (Financial)
Andhra Pradesh Electronic Dev. Corpn Ltd Hyderabad	Siemens AG West Germany	Electronic pushbutton telephones (Technical)
N S. Ravindran Madras 600006	Siemens AG West Germany	Electronic pushbutton telephones (Technical)
Steering Linkages Ltd	Sidermes SRL	Sensing and sampling devices,

Name & Address of the Indian Firm	*Name & Address of the Foreign Firm*	*Item of Manufacture (Nature of Collaboration)*
(1)	*(2)*	*(3)*
Rajkot 360003	Italy	Instruments and instrumentation systems (Technical)
Gujarat Communications & Electronics Ltd Vadodara 390005	Sony Corporation Japan	3/4 high band umatic professional video cassette recorders (Designs and drawings)
Punjab Wireless Systems Ltd Chandigarh 160055	OKI Electric Industries Ltd Japan	EPAX/EPABX and allied equipment (Technical)
United Electronics (I) Ltd Chandigarh	Fukuda Me Kogyo Co Ltd Japan	Automatic digital blood pressure monitors, digital clinical thermometers and automatic ECGs (Technical)
Larsen & Toubro Ltd Bombay 400038	Control Techniques Plc UK	AC inverters (Designs and drawings)
Teletherm Instruments Co Ltd Madras 600028	Penny Giles Data Recorders Ltd UK	Electronic items (Financial)
Dr Anil Kumar C/o Amil Electronics Ltd Patna 800020	Centre Engineering USA	Multilayer ceramic capacitors (Financial)
Debikay Electronics Calcutta 700088	Process Control Systems Inc. USA	Automatic gauge control systems (Designs and drawings)
ITL Computers (P) Ltd Hyderabad 500875	Bits & Bytes Inc USA	Floppy diskettes (Designs and drawings)
Maharashtra Electronics Corpn Ltd Bombay 400021	Dictaphone USA	Multichannel tape recorders and associated accessories (Technical)

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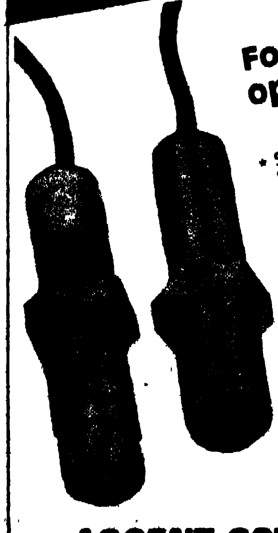

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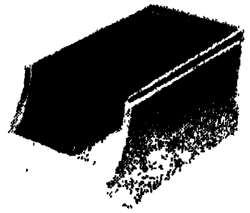
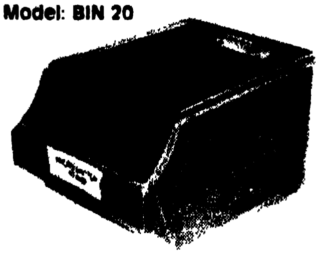
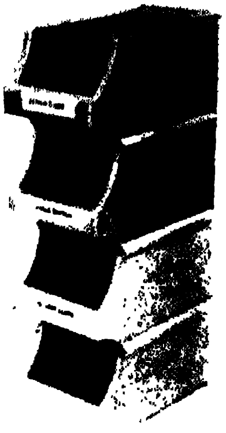


Model: BIN 20



Model: BIN 30



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INSIDE	205	180	118 mm
MAX. LOAD	13 Kgs.		

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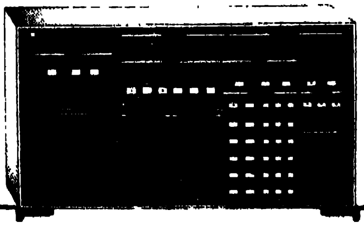

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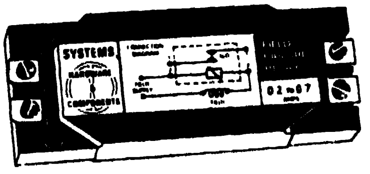

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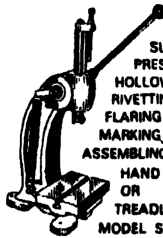

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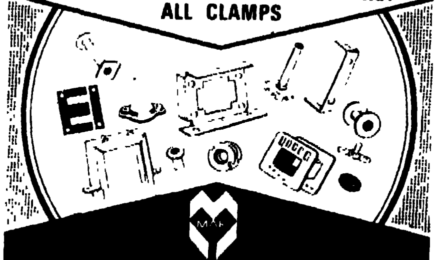

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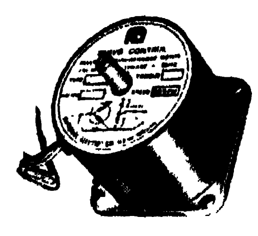

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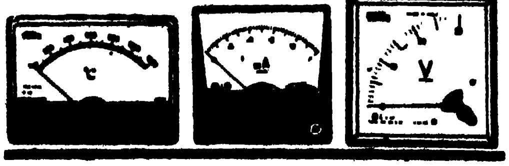

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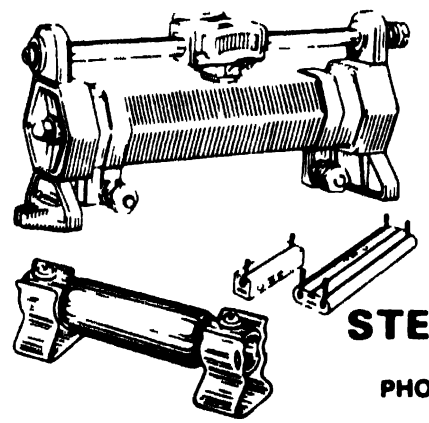

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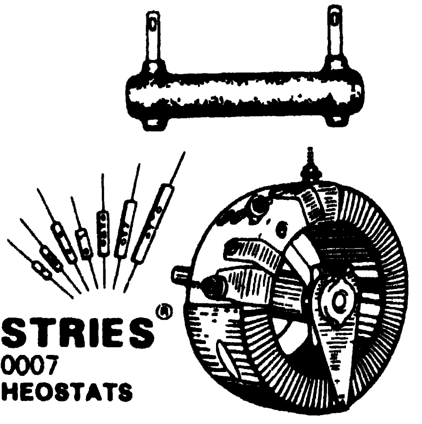

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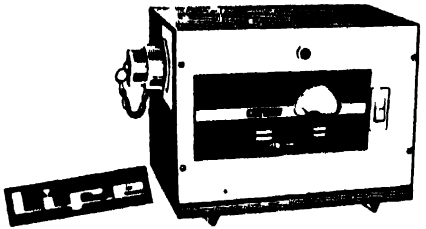

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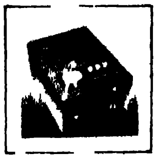

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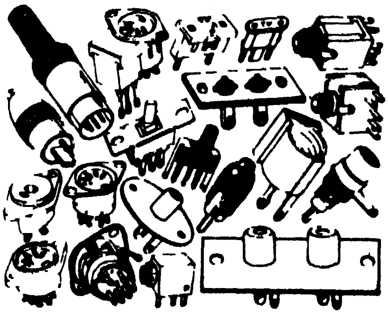

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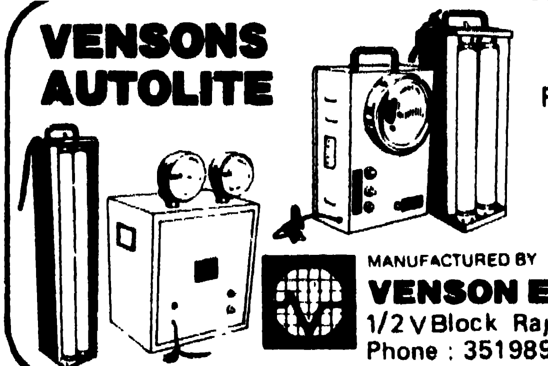

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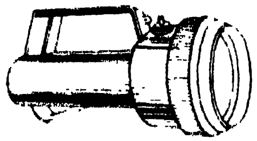

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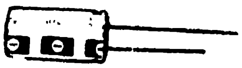

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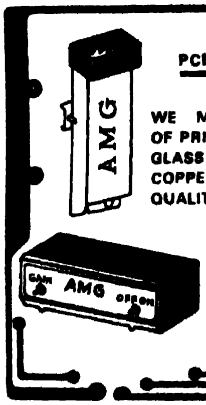

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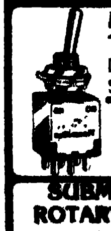

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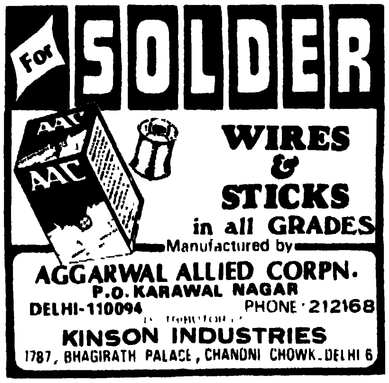
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B P B Publications 10
Balaji Engineering 84
Brisk Electro Sales 20
Cahners Exposition 49
Champion Electronics 42
Creative Data Systems 3
Data Byte 33, 75
Deki Electronics 6
Desco Electronic 6
Digital Promoters 9
Dominion Radios 34
Elcompo 50
Electro Systems Associates 15
Electronic Instruments & Controls 76
Hindustan Conductors 23
Hyderabad Connectronics 92
ITT, West Germany IV Cover
Inde Associates 12
Indian Biographical 39, 83
Indian Engineering 83
Integral Systems and Components 22
J J Electronics 76
Jeevan Deep Prakashan 47
Karnataka State Electronics 55
Keytron 57
Klas Engineering 15
Konark Television II Cover
Kwality Electricals 96
Lakshmi Electrical Control 97
Leader Electronics, Japan 41
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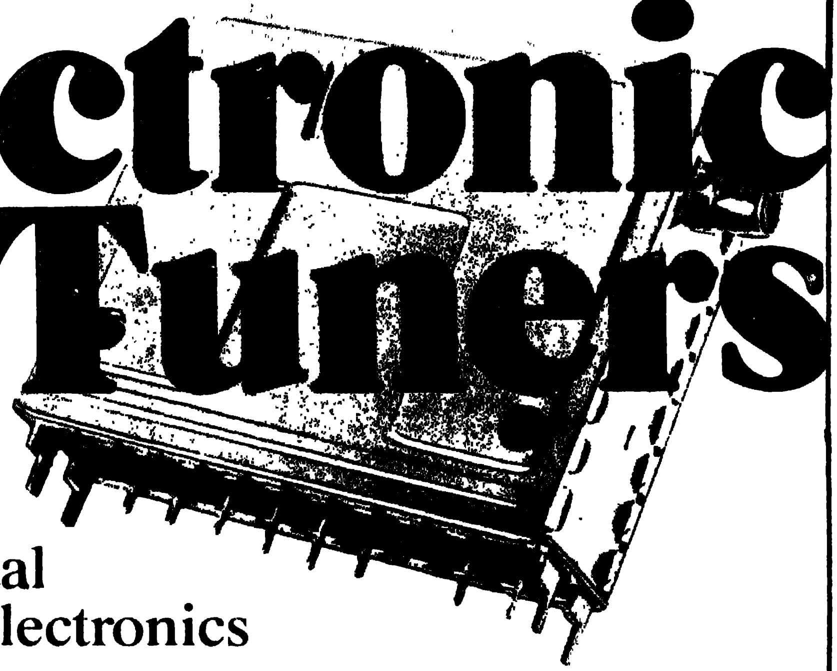

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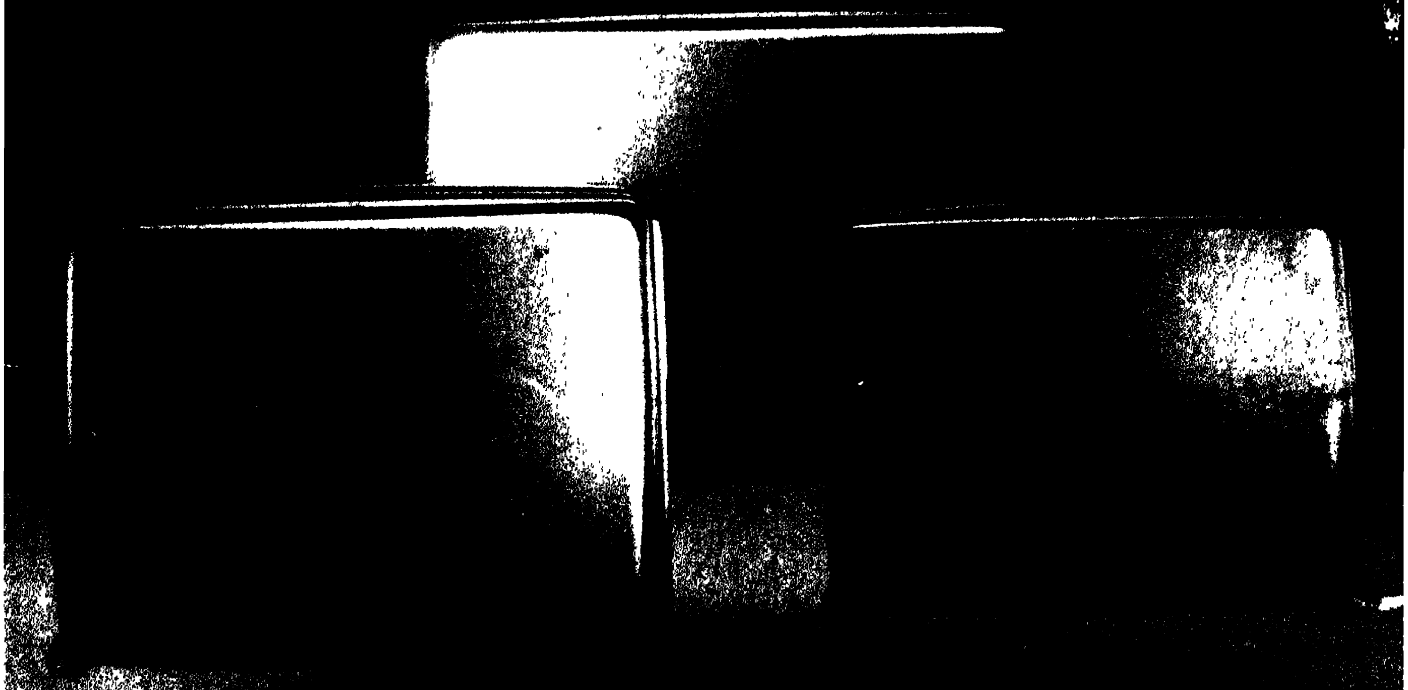

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